Vegetation classification of the proposed Heritage Park, North-West Province, South Africa.

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The earth will be filled with the knowledge and the glory of the Lord, as the waters cover the sea.

Habakkuk 2:14

Dedicated to my Creator, Redeemer and Friend, Who gave me life in abundance and promised to never leave, nor forsake me.

Abstract

The proposed Heritage Park will link Pilanesberg National Park and Madikwe Game Reserve with a corridor of approximately 170 000 ha, to form a conservation area of roughly 250 000 ha. This proposed Heritage Park will contribute to reaching the conservation target set for the Savanna biome. Developing a conservation area for eco-tourism will lead to job creation and it will increase the livelihoods of the people from the local communities. The escalating tourism demand at Pilanesberg and Madikwe, unique features, such as the Molatedi Dam, Marico River and Dwarsberg Mountains and the archaeological importance of the area further provides a strong motivation for the development of the proposed Heritage Park.

For effective planning, development and management of the proposed Heritage Park, it is essential to have a sound knowledge base of the ecosystems present and its biota. Several sub-research projects have been planned, including a soil and vegetation survey (of which the current study forms a part), a land and biodiversity audit, a socio-economic impact assessment, a game carrying capacity survey, spatial planning, heritage status and development and traditional knowledge surveys. No vegetation studies have previously been carried out in the central part of the corridor area, which covers a surface area of more than 90 000 ha. The aims of this study were to classify and describe the vegetation of the Central Corridor Area (CCA), to map plant communities, to identify and describe broad vegetation units and to integrate this study with previous studies carried out in other parts of the proposed Heritage Park.

Stratified, random sampling was done and 222 relevés were completed in the CCA. A total of 20 plant communities and 17 sub-communities were identified and described in four land types in the CCA, using the Braun-Blanquet approach. Data was processed using the TURBOVEG database and a visual editor for phytosociological tables, MEGATAB. The correlations between environmental variables and plant communities were identified with the use of Correspondence Analysis (CA) ordinations and Principal Component Analyses (PCA) ordinations in CANOCO. The plant communities and also the areas with serious bush thickening and old cultivated fields were mapped. The plant communities from different land types were combined into three vegetation units and four vegetation sub-units, which were described in terms of species composition and environmental variables and management recommendations were given. The first vegetation unit (the *Acacia robusta – Acacia tortilis* Vegetation Unit) was found on deep soil, on plains. The second vegetation unit (the *Mundulea sericea – Vitex zeyheri* Vegetation Unit) was also found on plains, but on shallow sandy soil. The third vegetation unit (the *Grewia flavescens – Panicum maximum* Vegetation Unit) was found on shallow, sandy and rocky soil on mountains. The vegetation classification of the CCA was also compared with the vegetation studies carried out in the Expansion Areas of Madikwe and Pilanesberg.

Opsomming

Die voorgestelde Heritage Park gaan die Pilanesberg Nasionale Park en die Madikwe Wild Reservaat aan mekaar verbind deur ŉ korridor van nagenoeg 170 000 ha, om sodoende ŉ bewaringsgebied van ongeveer 250 000 ha te vorm. Die voorgestelde Heritage Park sal daartoe bydra dat die bewaringsdoelwit wat vir die Savanna bioom gestel is, bereik word. Die ontwikkeling van ŉ bewaringsgebied vir ekotoerisme sal tot werkskepping lei en dit sal ekstra inkomste vir die plaaslike gemeenskappe genereer. Die toenemende aanvraag vir toerisme by Pilanesberg en Madikwe, unieke kenmerke, soos die Molatedi Dam, Marico Rivier en die Dwarsberge sowel as die argeologiese belangrikheid van die gebied verskaf verder ŉ sterk motivering vir die ontwikkeling van die voorgestelde Heritage Park.

Vir die effektiewe beplanning, ontwikkeling en bestuur van die voorgestelde Heritage park, is dit noodsaaklik om deeglike agtergrondskennis van die ekosisteme wat teenwoordig is te hê asook van die biota wat voorkom. Verskeie sub-navorsingsprojekte is beplan, insluitende ŉ grond- en plantegroeistudie (waarvan hierdie studie ŉ deel vorm), ŉ land en biodiversiteit oudit, ŉ sosio-ekonomiese impakstudie, ŉ wild drakapasiteit studie, ruimtelike beplanning, erfenis status en tradisionele kennis studies. Geen plantegroeistudies is voorheen in die sentrale deel van die korridor gebied, wat ‘n oppervlakte van meer as 90 000 ha beslaan, uitgevoer nie. Die doelstellings van hierdie studie was om die plantegroei van die Sentrale Korridor Gebied (SKG) te klassifiseer en te beskryf, om die plantgemeenskappe te karteer, om breë plantegroei eenhede te identifiseer en te beskryf en om hierdie studie met vorige studies wat in ander dele van die voorgestelde Heritage Park gedoen is te integreer.

Gestratifiseerde, onwillekeurige opnames is gedoen en 222 relevés is in die CCA voltooi. ŉ Totaal van 20 plantgemeenskappe en 17 sub-gemeenskappe is in vier landtipes in die SKG geïdentifiseer en beskryf, deur van die Braun-Blanquet benadering gebruik te maak. Data is met behulp van die TURBOVEG databasis en ŉ visuele verwerker vir fitososiologiese tabelle, MEGATAB, verwerk. Die korrelasies tussen die omgewingsveranderlikes en die plantegroei-gemeenskappe is met behulp van Korrespondensie Analise ordeninge en Hoof Komponent Analise ordeninge in CANOCO geïdentifiseer. Die plantegemeenskappe, sowel as die gebiede met ernstige bosverdigting en ou landerye is gekarteer. Die plantgemeenskappe van die verskillende landtipes is in drie plantegroei eenhede en twee plantegroei sub-eenhede gekombineer. Die eerste plantegroei eenheid (die *Acacia robusta – Acacia tortilis* Plantegroei Eenheid) is op diep grond, op vlaktes aangetref. Die tweede plantegroei eenheid (die *Mundulea sericea – Vitex zeyheri* Plantegroei Eenheid) is ook op vlaktes aangetref, maar op vlak, sanderige en klipperige gronde en die derde plantegroei eenheid (die *Grewia flavescens – Panicum maximum* Plantegroei Eenheid) is op vlak sanderige en klipperige grond, op berge aangetref. Hierdie eenhede is beskryf in terme van spesiesamestelling en omgewingsveranderlikes en bestuursvoorstelle is gegee. Die plantegroei-klassifikasie is verder vergelyk met die plantegroeistudies wat in die Uitbreidings Gebiede van Madikwe en Pilanesberg uitgevoer is.

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Chapter 1
Introduction

1.1 The importance of conservation and ecotourism

The rapidly growing human population poses an increasing threat to the natural resources of the environment and leads to overexploitation and poverty (Meffe & Carroll, 1997; Primack, 2008). There are many complex processes threatening the health and future of our planet, including climate change, species extinction, degradation of ecosystems, growing social inequalities and the challenge to feed a growing population (IUCN, 2009b). If these threatening processes are not changed, it can lead to irreversible environmental damage. In South Africa the population has grown from 5.17 million in 1904 to 45.9 million in 2004, which means that there are eight times more people now, than hundred years ago (Department of Environmental Affairs and Tourism, 2006). If the natural environment is not conserved it will have catastrophic consequences for nature itself and also for the human race in the long-term as we are dependent on it for food, water, fuel, shelter, construction, recreation, aesthetic, cultural and spiritual needs (Hunter, 2002; Department of Environmental Affairs and Tourism, 2006; Primack, 2008).

One aspect of conservation is the establishment of protected areas in which ecosystems and all the species that form part of it are being conserved. Protected areas play a prominent role in resolving problems of poverty, water shortage, climate change and biodiversity loss (IUCN 2009a). Resolution No. C/69/35 of March 2008 of the IUCN Council identified protected areas and global change as the highest priorities in the IUCN programme of 2009 – 2012 (IUCN 2009a). Even if these protected areas only cover a small part of the earth's surface, it can still protect a considerable number of species (Primack, 2008). Primack (2008) further stated that an area that covers 10 % of a countries surface area should protect approximately 50 % of its species. If a national park is however established where a concentration of species occur, this percentage will be much higher (Primack, 2008).

South Africa hosts a wide range of ecosystems, including nine biomes, namely the Fynbos, Succulent Karoo, Desert, Nama-Karoo, Grassland, Savanna, Albany Thicket, Indian Ocean Coastal Belt and Forest Biomes (Mucina & Rutherford, 2006). The study area falls within the Savanna Biome, which will be discussed in more detail in Chapter 2. Although South Africa occupies only 2 % of the earth's surface, it contains nearly 10 % of the world's plant species and 7 % of reptile, bird and mammal species (Department of Environmental Affairs and Tourism, 2006). South Africa has the fifth highest number of plant species in the world. The greatest cause of biodiversity loss in the terrestrial environment is the loss and degradation of natural habitat (Department of Environmental Affairs and Tourism, 2006). Only 6 % of South Africa's terrestrial ecosystems, 7 % of total river length and 18 % of wetlands are formally protected, which is not sufficient (Department of Environmental Affairs and Tourism, 2006).

In the North-West Province, 54 % of the Savanna biome has been transformed to agricultural land. Savannas are further threatened by overgrazing, bush thickening, mining, and urbanization (State of the Environment Report: North-West Province, 2002). Most of the vegetation types found in the North-West Province are poorly represented in conservation areas (State of the Environment Report: North-West Province, 2002). According to Mucina & Rutherford (2006) the Savanna biome covers 32.5 % of South Africa. Only 8.8 % of the Savanna biome in South Africa and a mere 2.6 % in the North-West Province are protected in national parks, provincial and local authority reserves (Mucina *et al*., 2005; Mucina & Rutherford, 2006). The conservation target for the Savanna biome is a minimum of 16 % and a maximum of 25 % (average 20 %), as this will represent 75 % of all the species that occur within this vegetation type (Mucina & Rutherford, 2006). It is therefore of great importance to expand the protected areas in the Savanna biome in South Africa and specifically in the North-West Province.

Conservation should never be considered in isolation from economic and social factors as these factors are all interdependent (Department of Environmental Affairs and Tourism, 2006). It is especially important to consider communities that are affected and often dependant on such developments. According to Reid (1999), ecotourism is 'tourism that focuses on conservation of the environment while creating benefits for local populations and communities'. Through ecotourism activities, economic factors and education of local people and tourists are also taken into consideration (Diamantis, 2004). In former years local communities often did not benefit from conservation areas, resulting in general hostility towards conservation (Chenje & Johnson, 1994). Simelane *et al.* (2006) stated that a conservation project should aim to bring social and economical prosperity to communities that are influenced by the development. When local communities are involved in conservation and benefit from it, they develop a sense of ownership and conservation becomes a priority to them. Without the cooperation of the local communities that are affected, conservation can never be successful (Reid, 1999). According to Barrow (2006) tourism provides more than one in fifteen of all the jobs in the world. Tourism can therefore make a significant contribution to the economy of a country, especially in South Africa. The approach of tourism however needs to be sustainable to be lucrative over the long term (Barrow, 2006).

1.2 Background to Pilanesberg National Park and Madikwe Game Reserve

Two of the existing conservation areas in the North-West Province are Pilanesberg National Park and Madikwe Game Reserve. The North West Parks and Tourism Board plan to combine these two conservation areas with a corridor to form one large nature reserve (Boonzaaier & Lourens, 2002). This will increase the area that is protected in the North-West Province and it will be a great asset towards ecotourism. An enlarged conservation area will also benefit the economy of South Africa and the North-West Province as a whole and will contribute to the livelihoods of the adjacent communities if they from part of and profit from the development.

The Pilanesberg National Park was proclaimed as a reserve in 1979 (Boonzaaier & Collinson, 2000) and covers an area of 46 000 ha (Boonzaaier & Lourens, 2002). Pilanesberg is found on an alkaline ring complex which was formed by volcanic eruptions some 1 200 million years ago. The Pilanesberg Alkaline Ring complex is of great geological importance as it is one of three alkaline volcanoes in the world and the most clearly defined one. Before its proclamation as a reserve it was degraded and depleted of indigenous game species. After the proclamation, the area was restored and restocked with game. Tourism infrastructure was developed and presently it is a very successful and popular tourism destination. The Pilanesberg National Park is characterised by a wide variety of landscapes and associated vegetation. It is known for spectacular scenery and provides a wide range of habitats for game. Many species of game can be viewed, including the Big Five. The focus of the Pilanesberg National Park is primarily on conservation (Boonzaaier & Collinson, 2000).

The Madikwe Game Reserve was proclaimed as a nature reserve in 1991, because a feasibility study showed that wildlife-based tourism was the most beneficial option for this area (Madikwe Development Task Team, 1994). The soil of Madikwe is not very fertile in general, which limits successful crop production (Hudak & Wessman, 2001) and formed part of the motivation for developing it as a game reserve. Madikwe Game Reserve covers a surface area of 61 000 ha (Boonzaaier & Lourens, 2002) and is located in the northern part of the North-West Province, with Botswana forming the northern border (Madikwe Development Task Team, 1994). Madikwe boasts a wide variety of habitats, including the Marico River, the Dwarsberg and Rand-van-Tweedepoort Mountains as well as smaller “koppies” (hills) and also large open flats (Madikwe Development Task Team, 1994). The greater the variety of habitats, the more plant and animal species can be accommodated (Van Rooyen, 2006) and there is indeed a wide variety of animals, including the Big Five (Madikwe Development Task Team, 1994). The focus at Madikwe Game Reserve is on the “tourism product” which includes, for example, viewing large mammals rather than conservation of species diversity and ecosystems in their natural state (Stalmans, 2007).

1.3 Heritage Park plans and motivation

Based on the success and growth experienced by Madikwe Game Reserve and Pilanesberg National Park it has been realised that expansion and eventually the combination of the two parks by means of a corridor is feasible and would be very beneficial to the different stakeholders. This proposed park will be called the Heritage Park and it will have an approximate size of 250 000 ha. The feasibility of the project has been examined in depth by Boonzaaier & Lourens (2002) by considering tourism demand in the North-West Province, socio-economic aspects, competition with other ecotourism opportunities in South Africa and other factors that might influence the Heritage Park plans. Boonzaaier & Lourens (2002) confirmed that it is “absolutely feasible and that it could substantially benefit the people of the region”. At first this park will most likely consist of a mosaic of different forms of ecotourism, but in future it may become one large game reserve in which game, including the Big Five will be able to move throughout the entire park (Boonzaaier & Lourens, 2002).

There are several motivations for developing the Heritage Park, including the expansion of protected areas, growth in tourism demand at Madikwe and Pilanesberg, community development and job creation and to conserve the archaeological heritage of the area. The connection of Madikwe and Pilanesberg will further allow animals to migrate over the entire area. According to Meffe and Carroll (1997) the connection of different habitat patches through corridors allows movement and re-colonization between reserves. Wildlife corridors have two main purposes, namely to allow periodic movements between different habitat types used for different purposes such as breeding, feeding, roosting etc. and to allow permanent immigration and emigration for individuals among habitat patches that allow gene flow and re-colonization after local extinction (Meffe and Carroll, 1997). Rare game species such as rhino, buffalo, roan and sable can also be bred in certain areas in the proposed Heritage Park (Boonzaaier & Lourens, 2002).

Over the past years Pilanesberg National Park and Madikwe Game Reserve have shown rapid growth in tourism (Boonzaaier & Lourens, 2002). Increasing demand creates an opportunity for the development of the proposed Heritage Park. As a result of the growing demand the area will need an additional 950 rooms in the medium term and another 430 rooms in the long term (Heritage Park, 2010). With current tourism demands soaring and tourism products at Pilanesberg and Madikwe having reached saturation levels, the expansion of Pilanesberg and Madikwe with the eventual aim of linking the two via a corridor is therefore believed to be a viable ecotourism destination (Boonzaaier & Lourens, 2002; Heritage Park, 2010). This expansion should take place over the next 15 to 20 years to meet the increasing tourism demand (Boonzaaier & Lourens, 2002; Heritage Park, 2010).

In some parts of the proposed Heritage Park for example the Fa and Fb land types, the soil are shallow and sandy, and thus not suitable for crop production, but there are also parts that are found on deep soil such as the Ae and Ea land types (Land Type Survey Staff, 1988). Crop production is possible in these deeper soil, but previous studies indicated that nature-based tourism will be a much more beneficial land use than both crop production and cattle grazing (Hudak & Wessman, 2001, Boonzaaier & Lourens, 2002). According to the IUCN (2009a), wildlife-based land use under correct management, have proved to deliver sustainable income for rural communities in arid and semi-arid environments in southern Africa. It would therefore make economical sense to convert the farms which are presently used primarily for grazing to a conservation area with eco-tourism as the main income. Another great advantage is that eco-tourism has a considerable smaller impact on the environment than most other land use practices (IUCN, 2009a).

The area where the proposed Heritage Park will be developed is ideal for a game reserve, as it include the beautiful Dwarsberg Mountain range, Molatedi Dam and Marico River. The area also offers the opportunity for recreational activities such as rock climbing, abseiling, water sports, quad biking, cycling and of course game viewing in an aesthetically appealing environment (Boonzaaier & Lourens, 2002). Another great advantage is that the area is Malaria free (Madikwe Development Task Team, 1994). Such a project will therefore increase tourism, which will in turn contribute significantly to the local, region and country's economic development as a whole.

The proposed Heritage Park is bordered by 33 villages (Boonzaaier & Lourens, 2002). According to the Department of Environmental Affairs and Tourism (2006), 56 – 70 % of the people in the region are poor, in other words, they lack adequate access to key resources needed for full participation in an economic and social life. In the Mankwe and Madikwe regions, north of the study area, only 36 % of the community is employed (Boonzaaier & Lourens, 2002). According to Boonzaaier & Lourens (2002), employment in the study area is expected to be even lower, as it is relatively far away from the mining, industrial and tourism activities of the region. Some of the people from these communities are employed by the platinum mines in Rustenburg, which are 100 km south-east of Dwarsberg. Any additional form of socio-economic development will increase the livelihoods of especially the women and youth of the rural communities, who cannot work in the mines. People will be needed in the establishment phases of the park, which includes the construction of roads and buildings, fencing, de-bushing of encroached areas, soil reclamation activities, etc. More jobs will be created when the park has been established, such as entry control, lodge and resort operators, tour guides, cleaning and maintenance staff, production and selling of curios. Tourists could also be hosted and entertained by communities in and around the park. These new job opportunities will raise the standard of living of the people from the local communities (Heritage Park, 2010). Some projects have already started, such as, training of the local people as field guides. Four of these guides were also employed during this and other studies to help with the fieldwork. As the local communities realise that the proposed Heritage Park will be beneficial to them, they will hopefully give their cooperation. There is however still a long way to go to win the trust and confidence of the local communities.

Another reason why the area should be conserved is that late Iron Age tools and signs of old Batswana settlements were discovered on the Dwarsberg Mountains. These findings should be protected and can also serve as a tourist attraction (Heritage Park, 2010).

1.4 The importance of research in planning, development and management of the proposed Heritage Park

For the Heritage Park project to be successful, proper planning and research is of the utmost importance. It is important that the aims of the project and the best way to approach it should be clear (Sutherland, 2000). According to Van Rooyen (2006) a proper management programme is a prerequisite for managing, conserving and utilizing ecosystems. The only way a thorough management plan can be developed is by first having a sound knowledge base of the natural resources of the environment that is going to be developed (Van Rooyen, 2006). The importance of research cannot be over emphasized, especially in terms of habitat composition, grazing and browsing capacity as well as socio-economic factors (Bothma, 2006; Bezuidenhout, 2009).

Several sub-research projects were initiated in the proposed Heritage Park, including a soil and vegetation survey (of which the current study forms a part), a land and biodiversity audit, a socio-economic impact assessment, a game carrying capacity survey, spatial planning, heritage status and development and traditional knowledge surveys. These projects will give an excellent overview of the current situation in the area and how to best approach the whole project. Several of these projects are currently in progress, including the soil and vegetation survey, the biodiversity audit (including plants, small mammals and birds), the game carrying capacity survey, social surveys and traditional knowledge surveys.

In the past conservation in Southern Africa focussed mainly on large mammals, but people realized that whole ecosystems have to be conserved (Chenje & Johnson, 1994). It is often large animals that attract tourists, but these animals are dependent on plants and other components of the environment (Chenje & Johnson, 1994). Conserving and enhancing plant diversity will contribute to combating climate change and to promote sustainable development (IUCN, 2009b). Environmental variables such as soil and topography influence the distribution of plant communities which in turn greatly influence the distribution of animals. Van Rooyen (2006) stated that vegetation is probably the most influential characteristic of a habitat and that vegetation gives a good indication of the general health of an ecosystem. Thorough knowledge of the plant communities is necessary for the development of a scientifically-based management plan (Van Wyk & Bredenkamp, 1986; Bezuidenhout, 2009). This thesis focuses on the vegetation classification of the Central Corridor Area (CCA) of the proposed Heritage Park.

According to Dengler *et al*. (2008) phytosociology is “a subset of vegetation science that deals with extant plant communities and puts particular emphasis on their classification”. Phytosociology is often referred to as the Braun-Blanquet approach as it was developed by Josias Braun-Blanquet in the 1920s (Dengler *et al*., 2008). Werger (1974) stated that the Braun-Blanquet approach is a scientifically sound, versatile and efficient vegetation classification method. Phytosociology is the main vegetation classification approach that is used in Europe and has become increasingly popular worldwide since the 1990s (Dengler *et al*., 2008). Phytosociology is also the standard vegetation survey technique in South Africa (Bredenkamp & Bezuidenhout, 1995) and it was therefore also the approach followed in this study. Phytosociologically defined habitat types play a critical role in delimitation, inventory, monitoring and management of protected areas, and the setting of conservation priorities (Dengler *et al.*, 2008). The Braun-Blanquet method was used successfully to classify vegetation in the Savanna biome by amongst others, Coetzee (1974, 1975); Van der Meulen (1979); Brown (1997); Van Staden & Bredenkamp (2005); Barrett *et al.* (2006); Pienaar (2006); Siebert & Eckhardt (2008) and Mostert *et al*. (2009).

1.5 Previous vegetation studies in the Savanna biome surrounding the CCA

Several vegetation studies have been carried out in the area surrounding the Central Corridor Area (CCA) (Table 1.1). The vegetation units identified and described in the CCA were compared to the broad vegetation types identified by Winterbach (Chapter 8). The comparison between the work done by Stalmans & De Wet and this study carried out in the CCA can be found in Chapter 9 and the comparison with the other studies in Chapters 4-7.

Coetzee (1972) did a phytosociological classification of the Jack Scott Nature Reserve. A total of 229 relevés were carried out and six mayor vegetation types were identified and described. Coetzee (1972) found that there is a great variation in the vegetation of the Jack Scott Nature Reserve.

The aim of the study carried out by Morris (1972) was to determine the influence of soil types on the distribution and floristic composition of plant communities and to describe one of these communities quantitatively and qualitatively. The study was carried out in the Lower Crocodile valley in the North-western Transvaal. The study showed that the distribution of plant communities and soil types were approximately 70 % similar (Morris, 1972).

Table 1.1 Vegetation studies completed in the area surrounding the Central Corridor Area (CCA) of the proposed Heritage Park.

Study area	**Author**	**Date**
Jack Scott-Nature Reserve	B.J. Coetzee	1972
The sweet bushveld on the farms Looplaagte 56 KP, Symanslaagte 74 KP, Hartbeeskuil 51 KP, Buisdoorens 55 KP, Rans 53 KP and Fauré 72 KQ in the Thabazimbi district.	P.P.J. Morris	1972
Atherstone Nature Reserve	J.C. Pauw	1988
Western Transvaal Bushveld	F. Van der Meulen	1979
Madikwe Game Reserve	P. Zacharias	1994
Borakalalo Nature Reserve	L.R. Brown	1997
Central Savanna	R. Winterbach	1998
Madikwe Game Reserve Expansion Area (MGREA) and Pilanesberg National Park Expansion Area (PNPEA)	M. Stalmans & F. De Wet	2003
Marakele National Park	P.J. Van Staden & G.J. Bredenkamp	2005

Pauw (1988) surveyed the environmental and plantecological aspects of the Atherstone Nature Reserve in the Limpopo Province. He further investigated the availability of browse and the habitat preferences of large animals and suggested guidelines for veld and game management. A monitoring program and the practical application of adaptive management were explained (Pauw, 1988).

Van der Meulen (1979) carried out extensive vegetation surveys in the former Western Transvaal. An area of 2 500 000 ha were studied using the Braun-Blanquet approach. Twenty-two new associations were described by Van der Meulen (1979). Three broad vegetation-habitat situations were identified, namely (1) macrophyllous thorny vegetation in warm, dry lowlands, (2) mesophyllous vegetation of cool, moist uplands and (3) transitional vegetation (Van der Meulen, 1979).

The vegetation of Madikwe Game Reserve was described by Zacharias (1994). Zacharias (1994) identified two major vegetation units, namely broad-leaved vegetation dominated by

Combretum species and microphyllous vegetation dominated by *Acacia* species. The broad-leaved vegetation was mostly located in wide east-west running strips. The microphyllous vegetation was associated with deeper soil, varying from red to yellow sands to black and grey cracking soil, while broad-leaved vegetation was found on elevated "koppies" of dolomite, chert and shale (Zacharias, 1994).

Brown (1997) classified the vegetation of the Borakalalo Nature Reserve using the Braun-Blanquet approach and he also derived a structural classification. He further compiled a vegetation map, described management units, determined veld condition and compiled a management plan. A total of 44 plant communities were identified, described and mapped and seven major vegetation types and thirteen management units were described (Brown, 1997).

Winterbach (1998) combined the data from 29 vegetation studies that was carried out in the Central Savanna of South Africa, including the abovementioned studies from Pauw (1988), Van der Meulen (1979) and Brown (1997). Winterbach (1998) identified four major vegetation types.

Stalmans & De Wet (2003) carried out soil and vegetation surveys in the Expansion Areas of Madikwe Game Reserve and Pilanesberg National Park. See Chapter 9 for the comparison of the study carried out in these Expansion Areas with the study carried out in the CCA.

The vegetation of Marakele National Park was described by Van Staden & Bredenkamp (2005) using the Braun-Blanquet approach.

Although several studies were carried out in the area surrounding the CCA and some broad classifications, such as Mucina & Rutherford (2006) included the CCA, a gap-analysis indicated that no in-depth vegetation studies were carried out inside this area. It is therefore of great importance to carry out a thorough vegetation classification following the Braun-Blanquet approach in the CCA. Mucina & Rutherford (2006) stated that in spite of many vegetation surveys carried out in the Savanna biome, the coverage of each vegetation unit is still very incomplete.

1.6 Aims of this study

The aims of this study included to:

- Identify, classify and describe the vegetation of the Central Corridor Area (CCA) of the proposed Heritage Park, based on species composition and relating this to environmental variables, such as soil and topography.
- Map the plant communities of the CCA.
- Combine the plant communities from different land types into vegetation units and describe these in terms of species composition, environmental variables and management issues.
- Integrate the data from this study carried out in the CCA with previous studies of adjacent areas (the expansion areas of Pilanesberg and Madikwe surveyed by Stalmans & De Wet (2003)).

1.7 Contents of this thesis

In Chapter 2 an overview is given of the study area in terms of location, land use, land type, geology, soil, topography, climate and vegetation.

In Chapter 3 a description of the methods used to complete this study is given.

Chapters 4 to 7 give the classification and description of the plant communities found in the Ae, Ea, Fa and Fb land types respectively.

In Chapter 8 a synthesis of the vegetation of all the land types is given. Vegetation units are described in terms of environmental variables, species composition and general field condition and some management recommendations are given.

Chapter 9 gives the comparison between the vegetation of the study area and the Expansion Areas of Madikwe and Pilanesberg, which border on the study area.

Chapter 10 provides the concluding remarks regarding the entire study and recommendations are given for management and future studies.

In the annexure a species check list for the CCA is given according to Germishuizen *et al*. (2006).

Chapter 2
Study area

2.1 Location

The study area, also referred to as the Central Corridor Area (CCA) of the proposed Heritage Park, is located in the North-West and Limpopo Provinces, South Africa, with the greater part in the North-West Province (Figure 2.1). It is located in the area between Madikwe Game Reserve, Pilanesberg National Park and their Expansion Areas, latitudes: 24°44'00" to 25°02'30" S and longitudes: 36°35'45" to 27°02'15" E. The CCA forms the central part of the corridor between Madikwe Game Reserve and Pilanesberg National Park and covers approximately 90 000ha (Stalmans & De Wet, 2003).

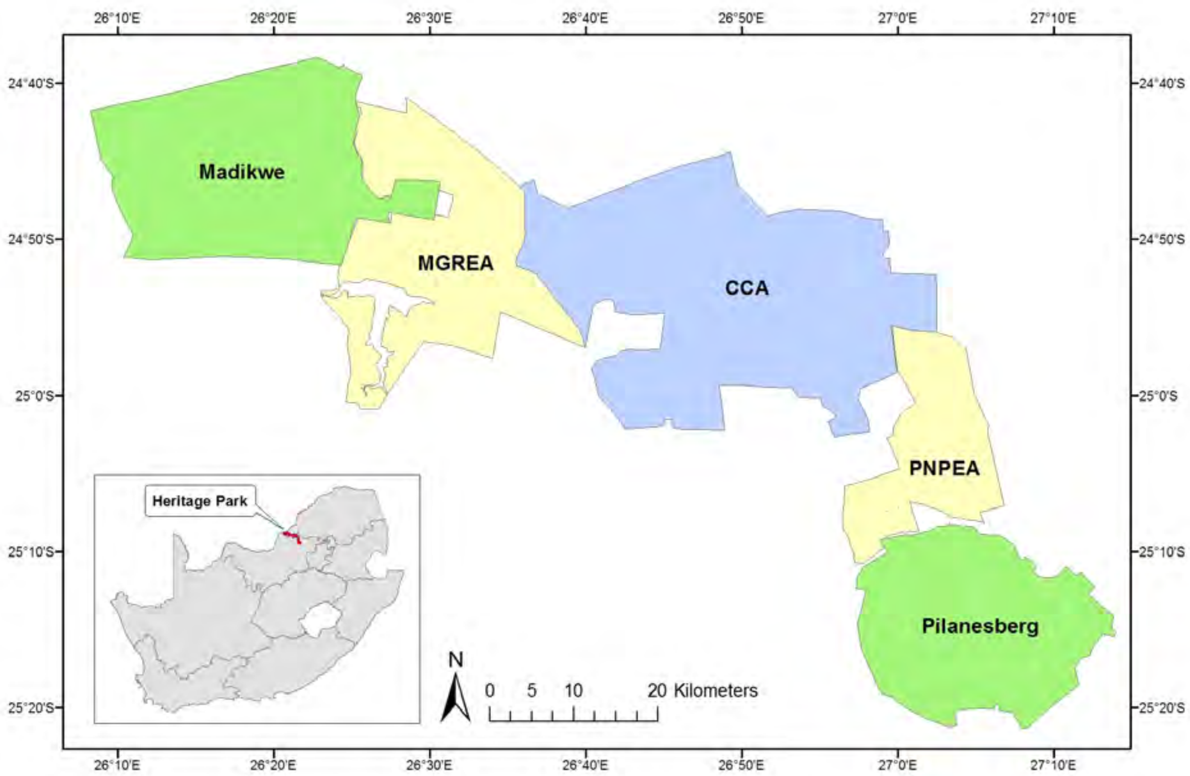

Figure 2.1 The location of the proposed Heritage Park in South Africa (overview map) and the location of the Central Corridor Area (CCA) with regards to the larger Heritage Park, which includes Madikwe Game Reserve, Madikwe Game Reserve Expansion Area (MGREA), Pilanesberg National Park Expansion Area (PNPEA) and Pilanesberg National Park.

2.2 Current land use

The Central Corridor Area (CCA) is currently used primarily for extensive cattle grazing, and a smaller part for ecotourism, dry land crop production and mining (Boonzaaier & Lourens, 2002). Thirty nine percent of the study area is trust land, 39 % is state owned, 21 % is private land and less than 1 % is tribal land. Approximately a third of the private land belongs to PPC (Pretoria

Portland Cement Company Limited) where they have a limestone quarry and a cement plant, known as the Dwaalboom facility, which was completed in 1984 (PPC, 2009). Most of the land at Dwaalboom has, however, not been mined yet. For the last 15 years it has neither been used for cattle grazing nor for crop production. There was however a fair amount of game in the area which caused some overgrazing. Bush thickening was a problem in this area and was most probably caused by overgrazing in the past.

2.3 Land type

Four land types were included in the Central Corridor Area, namely the Ae, Ea, Fa and Fb land types (Figure 2.2).The land types were numbered according to broad soil patterns: A, B, C etc. These were then divided into subdivisions and named with a small character a, b, c etc. Land types that occur more than once on the same map, are given separate numbers, for example the land type number Ae 33 was allocated to the thirty-third land type that qualified for inclusion in the broad soil pattern Ae (Land Type Survey Staff, 1988; Bezuidenhout, 1993). In the description of the communities, different numbers of a land type were mostly not distinguished, as no significant difference could be established.

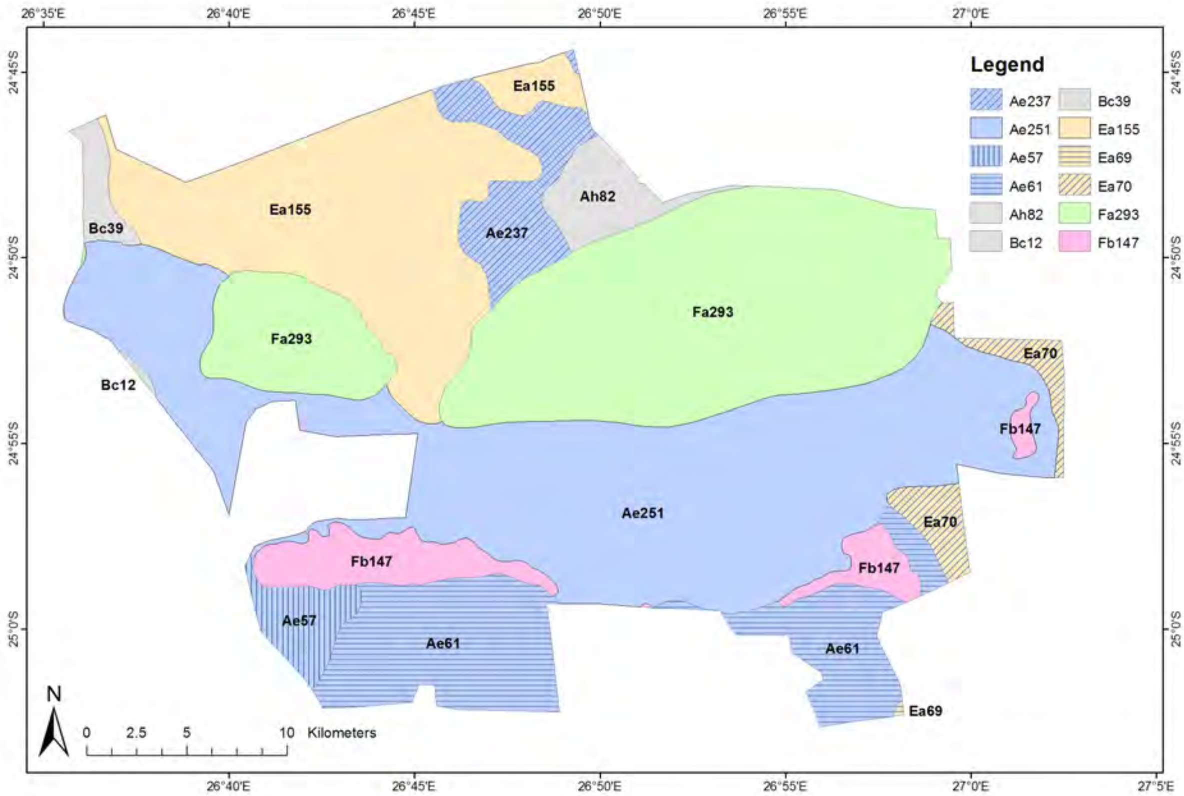

Figure 2.2 Land types of the Central Corridor Area of the proposed Heritage Park.

For a more detailed description of the geology, soil and vegetation of these land types, see the Introductions of Chapters 4-7.

2.4 Geology

The Central Corridor Area is underlain by two geological units, namely the Bushveld Complex in the larger, central area and the Transvaal Supergroup, on the eastern and western edges of the study area (Johnson *et al.*, 2006).

The Transvaal Supergroup is sedimentary rocks, such as quartzite and shale, which formed when sediments accumulated on the Kaapvaal Craton (McCarthy & Rubidge, 2005).

The Bushveld Complex is younger than the Transvaal Supergroup and is a body of mafic, igneous rocks of which platinum, chromium, vanadium and refractory minerals are derived (McCarthy & Rubidge, 2005). The Bushveld Complex consists of three different components that were formed in three different stages. First the Rooiberg group was formed by rhyolite eruptions on a floor consisting mainly of Transvaal Supergroup sedimentary rocks. Basaltic magma then intruded below the Rooiberg Group, forming a layer of about 8 km thick. This layer crystallised very slowly, allowing minerals to segregate into layers to form the Rustenburg Layered Suite. In the third and final stage, granitic magma intruded above the Rustenburg Layered Suite but below the Rooiberg group to form the Lebowa Granite Suite (McCarthy & Rubidge, 2005; Cawthorn *et al.*, 2006). The study area is found on the Rustenburg Layered Suite, which mainly comprises of the mafic layered rocks norite and gabbro.

2.5 Soil

The geology has a direct impact on the soil found in a specific area, as soil develops by the weathering of rocks (Ashman & Puri, 2005).

The soil varies from deep red and black clay soil (Rensburg soil form) to weakly developed shallow sandy soil (Rutherford & Westfall, 1994; Low & Rebelo, 1996; Mucina & Rutherford, 2006). There is a strong relationship between the soil and the vegetation types (Venter & Gertenbach, 1986; Morris, 1972). The soil will be discussed in Chapters 4–7, as there are significant differences between the soil from the different land types.

2.6 Topography

The altitude of the study area varies from 1 000 to 1 334 m above sea level. Mountains and smaller hills in the area include a part of the Dwarsberg Mountains, Tweneng, the hills at

Ramosibitswana and some smaller hills in the Fa land type. There are no permanent rivers in the CCA.

2.7 Rainfall and temperature

The study area falls into the summer rainfall area (Rutherford & Westfall, 1994). Data was obtained from several weather stations, but the rainfall data from Thabazimbi (60 km from the study area) and the temperature data from Pilanesberg (15 km from the study area) were used, as they were the most complete and up-to-date. Data was obtained from the South African Weather Services (2010). Average monthly minimum and maximum temperature are given for 2000 to 2009 in Figure 2.3. Temperatures were the highest from October to March, which were also the months with the highest precipitation (Figure 2.4). Average minimum and maximum temperatures for January 2000-2009 were 19˚C and 31˚C and for July 2000-2009 it were 3˚C and 22˚C (South African Weather Services, 2010). Total annual precipitation varied between 440 and 970 mm, with an average of 632 mm for the past 20 years (1990-2009) (Figure 2.5).

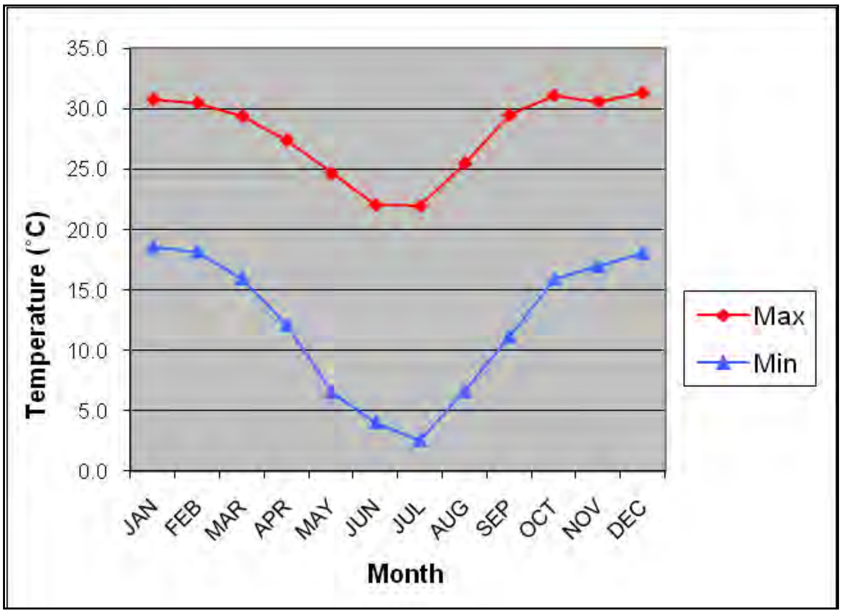

Figure 2.3 Diagram showing the average monthly minimum and maximum temperature for the years 2000 to 2009 as measured at Pilanesberg (South African Weather Services, 2010).

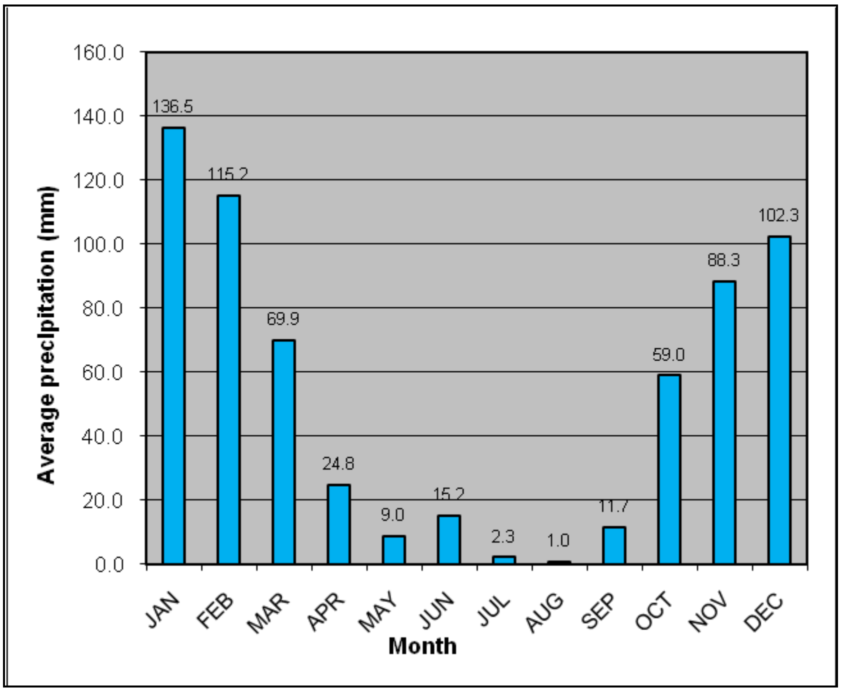

Figure 2.4 Mean monthly precipitation for the years 2000 to 2009 as measured at Thabazimbi (South African Weather Services, 2010).

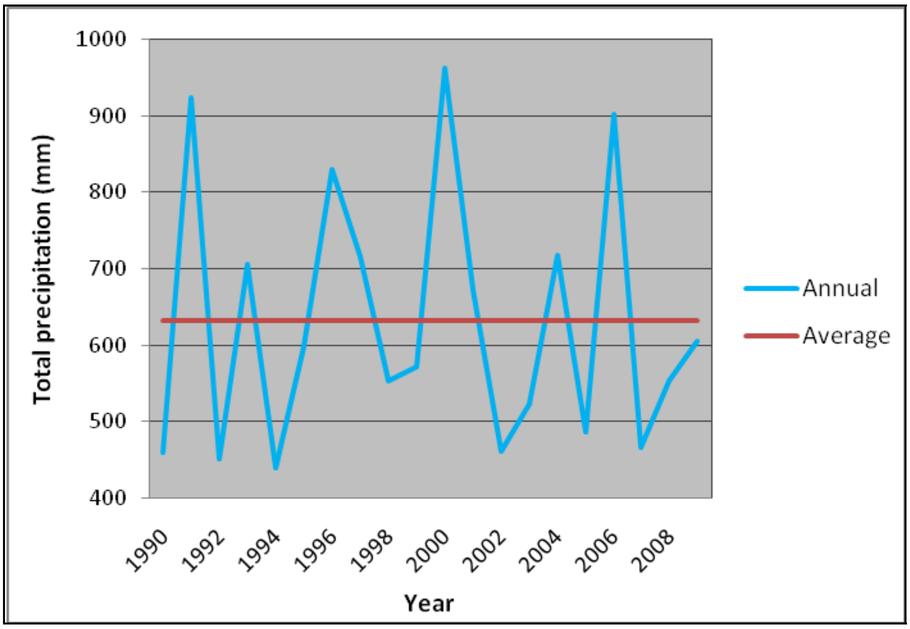

Figure 2.5 Total annual precipitation for the years 1990 to 2009 as measured at Pilanesberg (South African Weather Services, 2010).

2.8 Vegetation

The study area is situated in the Savanna biome (Acocks, 1988; Rutherford & Westfall, 1994; Low & Rebelo, 1996; Mucina & Rutherford, 2006) which is characterised by a grassy ground layer and a distinct tree layer. The Savanna biome is an important biome throughout Africa and is also found in other continents including South-America, Australia and India (Mucina & Rutherford, 2006).

The three environmental factors playing the most important role in the vegetation composition are (1) low precipitation, which prevent the upper layer from dominating, (2) fires and (3) grazing, which keeps the grass layer dominant (Low & Rebelo, 1996). The Savanna biome is mostly used for grazing, but where the soil is deeper, crop production and the cultivation of sub-tropical fruit is practiced.

The Savanna biome in South Africa is generally better conserved than most of the other biomes, mainly due to the presence of the Kruger National Park and the Kalahari Gemsbok National Park, now known as the Kgalagadi Transfrotier National Park, within this biome (Low & Rebelo, 1996). Conservation areas in the North-West Province include, amongst others, the Borakalalo Nature Reserve, Pilanesberg National Park, Madikwe Game Reserve and Magaliesberg Nature Reserve, which cover a surface area of 193 500 ha (Mucina *et al.*, 2005). As mentioned in Chapter 1, the percentage of the Savanna that is protected is however still very far from the conservation target, especially in the North-West Province (Mucina & Rutherford, 2006). Other conservation areas situated in the Savanna biome include the Mapungupwe, Marakele and Mokala National Parks, the Hlane Royal National Park, Blyde River Canyon Nature Reserve, Mlawula-, Ndumo-, and Hluluwe Mfolozi Nature Reserves (Mucina *et al.*, 2005).

Former classification by Acocks (1988) divided the Savanna biome into 12 subtypes, of which the study area falls into Other Turf Thornveld, Mixed Bushveld and Sourish Mixed Bushveld. Other Turf Thornveld is found on turf soil and is characterised by *Acacia* species. Mixed bushveld is found on shallow sandy soil and is characterised by more broad-leaved tree species, such as *Combretum* species, *Terminalia sericea*, *Sclerocarya birrea* and *Burkea africana.* It is a combination of sweetveld and sourveld (Acocks, 1988). Sourish Mixed Bushveld occurs on sandy loam soil between the sour types of the mountains and the mixed types of the plains and valleys. It is a rather open Savanna with *Acacia caffra* as the dominant tree in a fairly tall and dense grassveld (Acocks, 1988).

Sourveld is found in areas with high rainfall and often cold winters. The soil is not very fertile and has a low pH, because it has been leached due to high rainfall. This results in the grasses also being nutrient poor and unpalatable, especially in winter when the grasses withdraw nutrients from the leaves and store them in the roots (Van Oudtshoorn, 2004).

Sweetveld on the other hand occurs in areas with low rainfall and mild winters. The soil has a high fertility status, because little leaching occurs. The grass is more palatable and has a high nutritional value. The grass does not withdraw nutrients to the roots in winter and stays palatable throughout the year. Sweetveld is therefore easily overgrazed (Van Oudtshoorn, 2004).

After the Acocks (1988) classification, Low & Rebelo (1996) classified the largest part of the Central Corridor Area into Mixed Bushveld and a smaller part into Clay Thorn Bushveld. The Mixed Bushveld is found on shallow sandy soil overlaying granite, quartzite, sandstone or shale. It is dominated by broad-leaved tree species and represents a great variety of plant communities. The Clay Thorn Bushveld is found on vertic clays, derived from basalt and is dominated by *Acacia* species. It is poorly conserved (Low & Rebelo, 1996).

According to the most recent classification by Mucina & Rutherford (2006), the study area falls into three vegetation types, namely: Dwaalboom Thornveld (SVcb 1), Madikwe Dolomite Bushveld (SVcb 2) and Dwarsberg-Swartruggens Mountain Bushveld (SVcb 4). In Chapters 4–7 a description of these vegetation units is given.

2.9 Settlements

There are 33 villages or settlements mainly occupied by local, indigenous people surrounding the proposed Heritage Park. Only one settlement, namely Molatedi, will eventually be included in the proposed Heritage Park (Boonzaaier & Lourens, 2002). Some farm houses and semi-permanent structures near cattle pens and watering points were however encountered in the study area. It seems that many of the trust areas are overgrazed, especially on the footslopes of the mountains and bush encroachment is a serious problem in some of these areas.

Chapter 3
Materials and Methods

3.1 Survey techniques

3.1.1 Vegetation

A vegetation classification was carried out using the Braun Blanquet vegetation sampling approach (Muller-Dombois & Ellenberg, 1974). Stratified random sampling was conducted, using land types as the primary means of stratification (Figure 3.1). The land types were identified in 1988 by the Agricultural Research Council (ARC) (Land Type Survey Staff, 1988). Each land type displays a striking degree of uniformity with regards to terrain form, soil pattern and climate and it is shown on a scale of 1:250 000 (Land Type Survey Staff, 1988). These three abiotic factors, namely terrain form, soil pattern and climate, are closely related to vegetation patterns and therefore serve as a very useful tool in the stratification process (Bezuidenhout, 1993). Venter & Gertenbach (1986) found that the correlation between vegetation and soil types are exceptionally good. Other researchers that made use of land type maps in stratification include Bezuidenhout (1993), Cilliers (1998), Götze (2002) and Daemane (2007).

A reconnaissance survey was conducted and aerial photographs were used to refine the stratification and to determine the location of survey sites to be representative for the different homogenous units. The latter was challenging, due to the large surface area and rugged terrain of the study area and some land owners that opposed surveys on their farms. Stratifying and surveying the Fb land type thoroughly was especially challenging, due to its great diversity and inaccessibility which was caused by mountains, bad roads or no roads in some cases.

This study was carried out in conjunction with two other surveys in which the carrying capacity and small mammal diversity were determined. These surveys were carried out on a 200 m transect. To get a better representation of the diversity in each homogenous unit, two relevés were completed at each transect, one at the beginning of the transect and the other one at the end thereof. These transects were done parallel to the slope to get a better idea of the landscape. Most of the relevé pairs fell into the same plant communities, but there were some exceptions where they did not. An example of this is where a hill was sampled in the Fa land type and the one relevé was carried out at the bottom of the hill and the other one at the top. These two relevés fell into different communities. Although the 200 m transect method, where two relevés were chosen at the two ends of the transect, was maybe not the ideal method for the Braun Blanquet surveys, it was used to accommodate the other surveys carried out in conjunction with this study.

A total of 222 relevés were completed at the 111 sites for this study (Figure 3.1). A size of 20 m x 20 m was used for the relevés. In each relevé all plant species were recorded and cover abundance was estimated according to the Braun Blanquet scale (Table 3.1). Class 2 was however further divided into 2a and 2b, as in most South African studies (Bezuidenhout, 1993; Cilliers, 1998; Bredenkamp *et al*., 1999; Götze, 2002; Grobler *et al*., 2005; Daemane, 2007 and Pienaar, 2008). Cover in this thesis always refers to canopy cover. The physiognomy was also recorded at each relevé, which included the height and percentage cover of the tree-, shrub-, grass- and forb strata respectively.

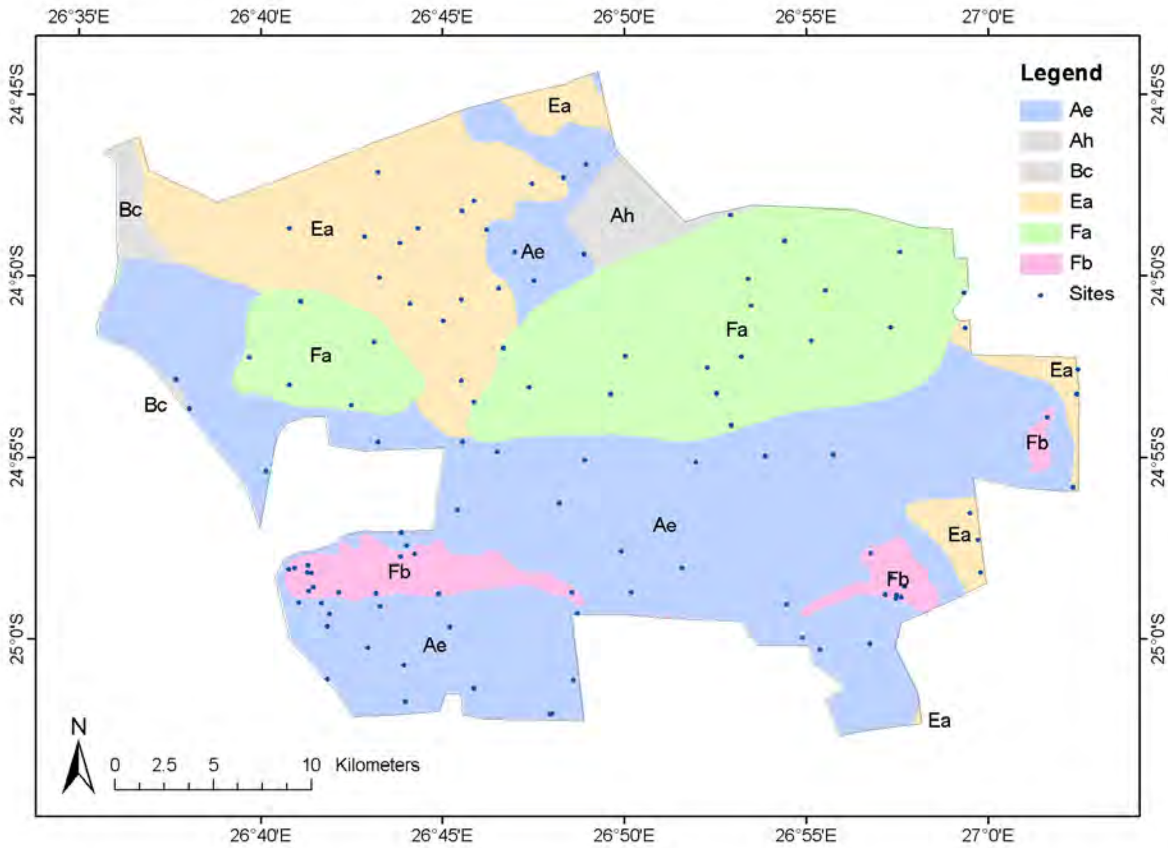

Figure 3.1 Land type map of the Central Corridor Area of the Proposed Heritage Park indicating the location of the survey sites.

3.1.2 Environmental factors and anthropogenic influences

Environmental factors, such as soil, topography and disturbance were also surveyed, as they have a significant influence on the distribution and composition of the plant communities (Morris, 1972; Bezuidenhout, 1993).

Table 3.1 The Braun-Blanquet cover abundance scale used in the vegetation classification of the Central Corridor Area of the proposed Heritage Park (Muller-Dombois & Ellenberg, 1974; Bezuidenhout, 1993).

Scale	Description
r	One or few individuals with less than 1% cover of the total sample plot area
+	Occasional and less than 1% cover of the total sample plot area
1	Abundant with low cover, or less abundant but with higher cover, 1-5% cover of the total sample plot area
2a	Abundant with >5 -12.5% cover of the total sample plot area, irrespective of the number of individuals
2b	Abundant with 12.5 - 25% cover of the total sample plot area, irrespective of the number of individuals
3	>25 - 50% cover of the total sample plot area, irrespective of the number of individuals
4	>50 - 75% cover of the total sample plot area, irrespective of the number of individuals
5	>75% cover of the total sample plot area, irrespective of the number of individuals

3.1.2.1 Soil analyses

Soil samples were taken to a depth of 1.2 m or less, depending on the occurrence of rocks. Soil were identified according to the Soil Classification system; a taxonomic system for South Africa (Soil Classification Work Group, 1991). Clay percentage was determined in the field by hand, using the ‘sausage’ method (Möhr, 1977).

A composite soil sample was taken of the A and B horizons at the beginning, middle and end of the 200 m transect at each site. Only one or two representative samples were analysed for each community or sub-community due to a limited budget for the soil sample analyses. Chemical analyses, as well as a particle size distribution were carried out, by the Eco-Analytica soil laboratory at the North-West University, Potchefstroom. Analyses were carried out according to the ‘Handbook of Standard soil testing methods for advisory purposes’ (Soil Science Society of South Africa, 1990). A basic soil chemical analysis was carried out, including the macro nutrients, pH (H_2O and KCl), electrical conductivity (EC), exchangeable cations, cation exchange capacity (CEC), S-value and base saturation.

Due to higher accuracy, the soil analyses from the laboratory results were used in the description of the communities.

Soil acidity is important as it influence the availability of nutrients. In alkaline soil for example, exchange sites are more likely to be dominated by sodium, calcium and magnesium, whilst in acidic soil it is more likely dominated by exchangeable aluminium (Ashman & Puri, 2005). Exchange sites are negatively charged sites on soil particles that have the ability to bind cations.

The cation exchange capacity (CEC) is the sum total of exchangeable cations that a soil can absorb. It is expressed in milli-equivalents per 100 grams or gram of soil (or other exchanger such as clay) (Winegarden, 1995). The CEC has a direct impact on the nutrient supply of the soil. Soil with a high CEC will have a higher concentration of nutrients such as K+, Ca+ and Mg2+, than soil with a low CEC (Ashman & Puri, 2005). Soil with a high CEC has the ability to buffer soil more effectively and it can also absorb pollutants better (Ashman & Puri, 2005).

According to the Soil Classification Work Group (1991) the S-value is the sum of exchangeable Ca, Mg, Na, and K, expressed in cmol (+) kg^{-1} soil.

In the description of the plant communities, the particle distribution was given for each community, as well as a textural classification (e.g. sandy loam) according to the classification chart by Winegardner (1995). Values of exchangeable cations were given when they were remarkably low or high compared to values for the other communities and compared to what is commonly found according to a communication by Mr. F. Botha (2010). A pH higher than 7.5 was considered as high for the study sites (Botha, 2010).

3.1.2.2 Topography

Slope, aspect and terrain unit were also noted. A terrain unit from 1 to 5 was assigned to each relevé (Figure 3.2). A plateau (1) is an upland with more or less a uniform summit level, sometimes bounded by one or more slopes falling steeply away. An escarpment (2) is a steep slope interrupting the general continuity of the landscape (Monkhouse *et al*., 1983). A midslope (3) is the upper part of the slope, the footslope (4) is the lower part of the slope and the valley bottom (5) forms the lowest part of the landscape.

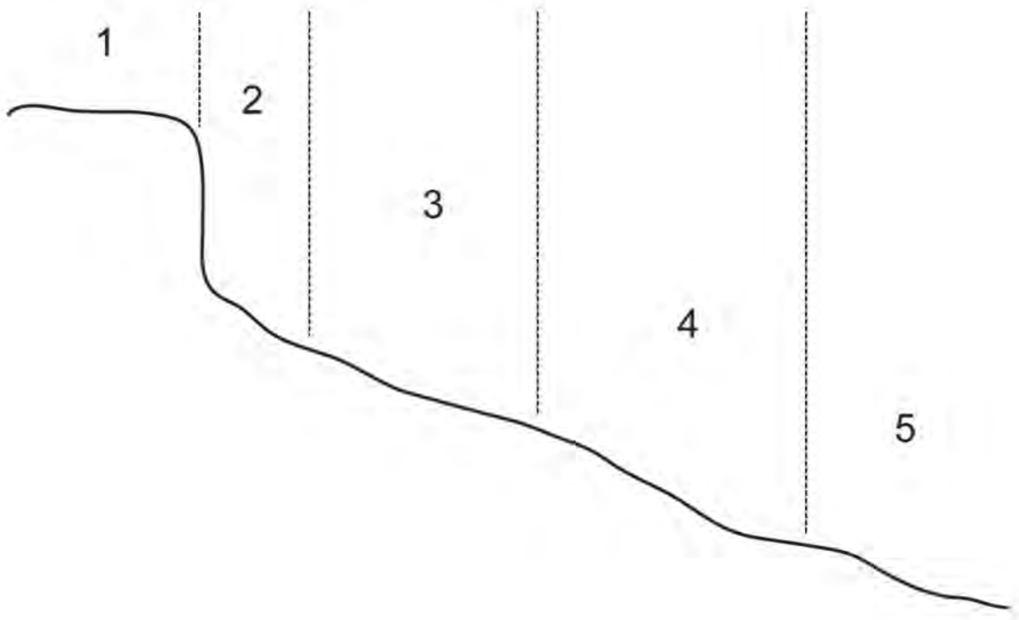

Figure 3.2 Explanation of terrain units: 1 – Plateau, 2 – Escarpment, 3 – Midslope, 4 – Footslope and 5 – Valley bottom. Adapted from Land Type Survey Staff (1988).

3.1.2.3 Disturbance

Erosion, compaction and overgrazing were estimated and described qualitatively as none, low, moderate or high. The types and extent of erosion were also noted, namely sheet erosion (uniform removal of topsoil from an area without the development of conspicuous water channels), rill erosion (removal of soil through the cutting of numerous small but conspicuous water channels), gully erosion (removal of soil giving rise to deep channels or gullies) and wind erosion (removal of topsoil by wind) (Land Type Survey Staff, 1988).

Overgrazing was subjectively estimated, according to the occurrence of different ecological status species, as classified by Van Oudtshoorn (2004) and according to aspects such as compaction and erosion. In the description of the plant communities only notable levels of disturbances were discussed. Where there was no disturbance it was not mentioned, except for the cases where it played an important role in distinguishing different communities.

Bush thickening and/or encroachment was estimated as a percentage. Averages were determined and mentioned in the description of each plant community.

Bush encroachment refers to the invasion of an undesirable woody plant into an area where it did not previously occur (Barac, 2003; Joubert *et al.,* 2008). Bush thickening, however refers to the phenomenon of increasing tree and shrub density, or the aggravation of existing undesirable plants in grassland and Savanna regions where woody species already occur naturally (Barac, 2003; Joubert *et al.,* 2008).

Although the term bush encroachment is often used in the literature for both these processes (Barac, 2003, Smit *et al.*, 1999, De Klerk, 2004), in this dissertation only the term bush thickening was used, as the problem in the study area was caused by already existing tree and shrub species that increased in density.

3.2 Data processing techniques

Floristic data was imported into the database TURBOVEG (Hennekens, 1996a) and then exported to the visual editor for phytosociological tables, MEGATAB (Hennekens, 1996b). The TWINSPAN (Two-way Indicator Species Analysis) classification algorithm (Hill, 1979) was applied to the dataset as a first analysis. The TWINSPAN classification was further refined by applying Braun-Blanquet procedures. This resulted in four phytosociological tables (one for each of the four land types). The plant communities and sub-communities were identified and described. No formal taxonomy was followed. When giving names to the communities, the diagnostic species and then the dominant species were given. In cases where the diagnostic species was also the dominant species the second dominant species was used in the name. The species that was used in the name for the community or sub-community was also chosen to represent the physiognomy of the vegetation. If, for example, a woody layer was present, it was attempted to include a woody species in the name and not only grasses. The communities were compared to previously identified and described communities in the region by Coetzee (1972), Morris (1972), Pauw (1988), Van der Meulen (1979), Zacharias, (1994) Brown (1997), Winterbach (1998) and Pienaar (2006) (Chapters 4-7).

Plant communities were mapped with the help of aerial photographs, a land type map and the location of the survey sites. Different colours were used to distinguish between the survey sites from different communities. Communities could then be mapped by looking at the distribution of these survey sites. This map is given in Chapter 9. Maps were created with the help of aerial photographs to show the location of old cultivated fields and areas with serious bush thickening (Chapter 8).

Two sets of ordinations were carried out in the CANOCO program (Ter Braak, 1986) for each land type, to illustrate the relationships between different plant communities and to identify possible environmental gradients that could be associated with vegetation gradients (Bezuidenhout, 1993) (Chapters 4-7). Several authors made use of ordinations to illuminate correlations between floristic data and environmental data, such as Morgenthal (2000), Götze (2002), Putter (2004), Greyling (2005), Daemane (2007) and Veldsman (2008).

Correspondence Analysis (CA) ordinations were carried out first, using vegetation data and environmental data. CA ordinations are based on the Unimodel Response Model in which each species is represented as a single mode. It is an indirect gradient analysis, which means that the variation within the vegetation data is examined independently from the environmental data. The environmental data is then correlated with the vegetation data (Kent & Coker, 1992; Lepš & Šmilauer, 2003). This ordination was chosen, as it is the best option to use when working with presence/absence data or when there are many zeros in the data (Kirkman *et al.*, 2009). A Detrended Correspondence Analysis (DCA) ordination was not necessary as no distortions could be observed in the CA ordinations. Step-by-step ordinations were carried out as described by Mucina & Van Tongeren (1989). This implies that a clearly distinguished community is removed and another ordination is done with the remaining communities until all the communities can be distinguished from one another.

Unlike for the first set of ordination where data from each relevé were used, averages for each community were used in the second set of ordinations. Principal Component Analysis (PCA) ordinations were done with the data from the soil analysis. PCA ordinations are based on the Linear Response Model. This model assumes that a species increase or decrease in a linear fashion (Kirkman *et al.*, 2009). A PCA is also an indirect gradient analysis (Lepš & Šmilauer, 2003). Species data are represented as arrows. In this study however, the soil data was treated as species data in the PCA ordinations. A PCA ordination was done because there were no zeros in the data and the data was not very complex. These ordinations illustrate the correlation between different plant communities and soil variables, such as pH, base status and particle size distribution.

MEGATAB (Hennekens, 1996b) was also used to combine the data from the four phytosociological tables in a synoptic table. The table was compiled from 222 relevés and consisted of 29 communities and sub-communities. The synoptic table was used to identify larger vegetation units, which together with data from the carrying capacity and soil studies done by F. Viljoen can be used to identify management units for the proposed Heritage Park (Chapter 8). Recommendations for the management of the different vegetation units were given in Chapter 8 and also general recommendations in Chapter 10.

A species check list was composed according to the names given by Germishuizen *et al*. (2006).

Chapter 4

Classification and description of the Ae land type

4.1 Introduction

The Ae land type covers the greatest surface area of all the land types in the study area. It consists of four different Ae land types (Ae 57, Ae 61, Ae 237 and Ae 251) (Figure 2.2), which has been regarded as one land type in this study, as no considerable differences were observed between them. A total of 86 relevés were completed for the Ae land type.

All the A land types consist of yellow and red soil. Soil forms in this land type include Inanda, Kranskop, Magwa, Hutton, Griffin and Clovelly (Land Type Survey Staff, 1988). Hutton and Clovelly soil were common in the Ae land type in this study. The A land types also refer to land which does not qualify as a plinthic catena and in which one or more of the above soil forms occupy at least 40 % of the area (Land Type Survey Staff, 1988). Kelley *et al.* (2008) defined plinthite as “an iron-rich, humus-poor mixture of clay with quarts and other highly weathered minerals”.

In the Ae land type yellow soil occupy less than 10 % of the area. Soil with a high base status occupy a larger area than dystrophic and/or mesotrophic soil, it is deeper than 300 mm and no dunes are present (Land Type Survey Staff, 1988). Dystrophic soil is soil with a low base status and mesotrophic soil is soil with a medium base status (Soil Classification Work Group, 1991).

The Ae land type in the study area falls into the Dwaalboom Thornveld. Mucina & Rutherford (2006) described the vegetation of the Dwaalboom Thornveld as plains with two strata: a tree layer which consists of scattered low to medium high, deciduous microphyllous trees and shrubs with a few broad-leaved tree species and an almost continuous herbaceous layer dominated by grass species. The Ae land type is characterised by *Acacia* species, mainly *Acacia tortilis* and *Acacia nilotica* on clayey soil and *Acacia erioloba* on sandy soil (Mucina & Rutherford, 2006). It was found on the plains north and south of the Dwarsberg. The slope was mostly between 1 and 5°.

Mucina & Rutherford (2006) described the geology and soil of the Dwaalboom Thornveld as vertic black ultramafic clays which develop from norite and gabbro, also locally in small depressions along streams. Some areas have less clayey soil, with high base status and eutrophic red soil. Underlying geology is the Archaean granite-gneiss terrain of the Swazain Erathem that is covered in parts by the mainly clastic as well as chemical sediments and volcanics of the Rayton and Silverton Formation, both of the Pretoria groups (Transvaal Supergroup). Mafic intrusive rocks of the Rustenburg Layered Suite, Bushveld Igneous

Complex (Late Vaalian) are present in the east and include the Bierkraal Magnetite Gabbro. Bronzite, Hartzburgite, Norite and Anorthosite are the major mafic rocks of the Rustenburg Suite (Mucina & Rutherford, 2006).

4.2 Plant communities of the Ae land type

The Ae land type includes the following five communities and five sub-communities (Figure 4.1, Table 4.1), namely:

1. *Aristida congesta* subsp*. barbicollis – Acacia tortilis* Community
    - 1.1 *Hermannia tomentosa – Dichrostachys cinerea* Sub-community.
    - 1.2 *Acacia robusta – Acacia nilotica* Sub-community
    - 1.3 *Sida dregei – Acacia tortilis* Sub-community
2. *Combretum imberbe – Heteropogon contortus* Community
3. *Euclea undulata – Acacia tortilis* Community
4. *Acacia erioloba – Panicum maximum* Community.
5. *Brachiaria eruciformis – Acacia tortilis* Community
    - 5.1 *Diospyros lycioides – Acacia tortilis* Sub-community
    - 5.2 *Aspilia mossambicensis – Acacia tortilis* Sub-community

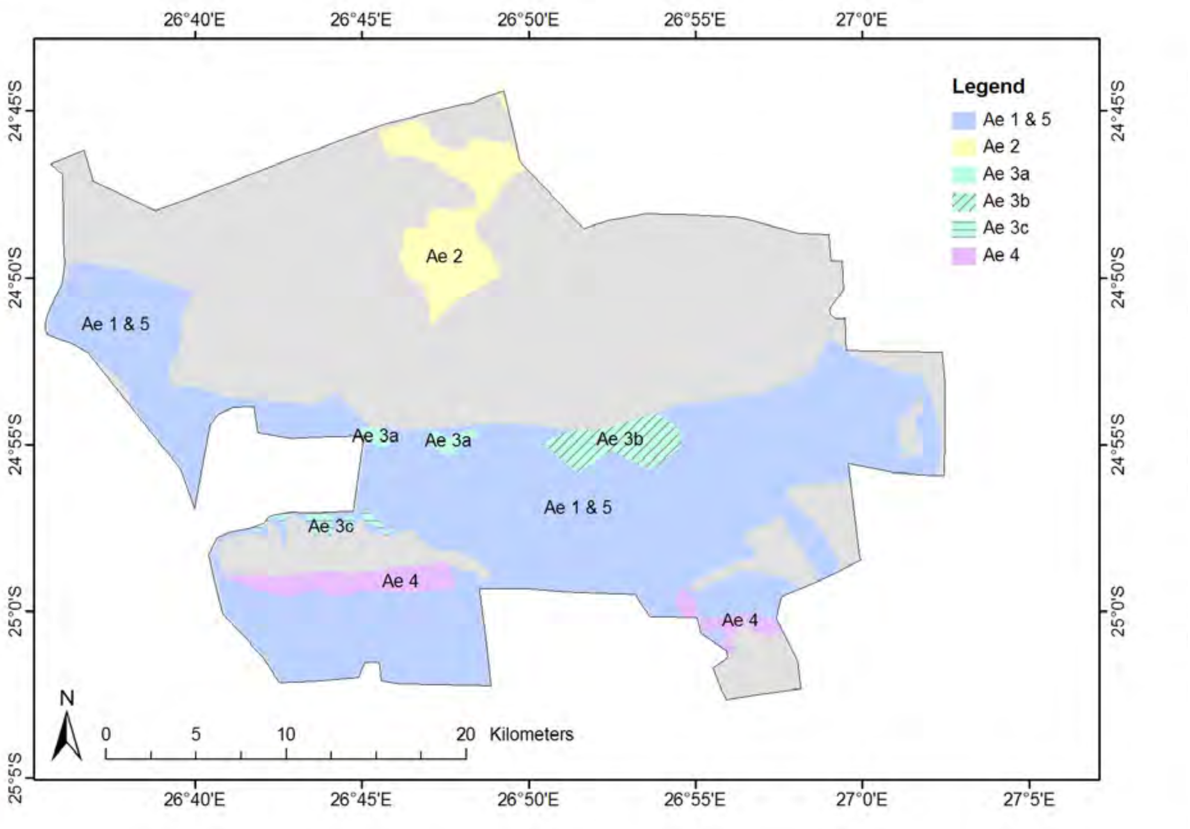

Figure 4.1 Map showing the communities of the Ae land type. Community 1 and 5 were mapped as one unit, as Community 5 was included as patches in Community 1 and the location of all of these patches was uncertain.

Table 4.1 Phytosociological table of the Ae land type of the Central Corridor Area of the proposed Heritage Park

Communities 1.1–1.3:

Site number																																				
					1	1	1	1	2	2	3	3	2	2	3	3	3	3	6	6	6	6	3	3	6	6	8	8	8	8	8	8	8	8	8	8
	1	1	2	2	0	0	6	6	9	9	2	2	8	8	1	1	4	4	6	6	9	9	0	0	4	4	0	0	1	1	5	5	6	6	7	7
Relevé number								2											1	1	1	1			1	1	1	1	1	1	1	1	1	1	1	1
					1	2	3	2	5	5	6	6	5	5	6	6	6	6	3	3	3	3	5	5	2	2	5	5	6	6	6	6	7	7	7	7
	1	2	3	4	9	0	1	0	7	6	2	3	4	5	0	1	6	7	0	1	6	7	8	9	6	7	8	9	0	1	8	9	0	1	2	3
Number of species	6	6	5	5	7	5	3	6	5	5	5	4	3	6	5	6	5	5	4	6	5	4	4	5	3	3	3	4	4	3	5	4	4	4	5	4
per relevé	8	8	7	7	0	7	8	2	3	7	6	3	9	4	0	2	1	2	7	1	0	7	8	2	9	5	7	3	2	6	1	8	9	0	4	9
Communities	1.1												1.2										1.3													
Species group A (Diagnostic species of Community 1)																																				
Aristida congesta s. barbicollis	.	b	b	.	a	a	.	b	1	a	.	.	.	+	+	+	+	+	3	a	+	.	.	+	+	.	1	1	+	.	.	1	1	+	+	1
Brachiaria nigropedata	.	+	+	+	.	+	+	+	+	a	+	.	.	+	+	+	+	+	+	.	.	.	+	1	+	.	+	1	1	.	+	+	+	.	1	+
Oxalis obliquifolia	.	+	.	.	+	+	+	+	+	+	.	.	.	+	.	.	1	.	+	+	+	+	.	+	.	.	.	.	+	.	.	+	.	.	+	+
Raphionacme hirsuta	.	r	+	.	+	+	.	.	+	.	.	.	.	.	+	+	+	+	+	.	.	.	+	+	.	.	.	.	+	+	+	.	+	+	+	+
Eragrostis superba	+	1	+	.	+	+	.	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	+	1	1	+
Crabbea angustifolia	+	.	.	.	+	+	.	+	.	.	.	.	.	.	+	+	+	+	+	.	.	.	+	1	.	.	.	.	.	.	1	+	.	.	+	+
Heliotropium steudneri	.	+	+	.	.	+	.	.	.	1	.	+	.	.	.	.	.	.	1	.	+	+	.	+	.	1	+	+	.	+	.	.	.	.	.	.
Anthephora pubescens	.	.	+	.	+	1	.	+	+	+	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	1	.	.	.	+	+
Commelina africana	.	+	.	.	.	.	.	+	1	+	.	.	.	.	.	.	.	.	.	.	+	.	+	+	.	.	.	.	1	.	+	+	.	.	+	+
Thesium utile	+	.	+	.	+	+	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	+	+	.	+	+	.	.	.
Ptycholobium plicatum	+	.	.	.	+	+	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	.	.	.	.	.	+	+	.	.	+	.	.	.
Blepharis integrifolia	+	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	+	.
Species group B (Diagnostic species of Sub-community 1.1)																																				
Hermannia tomentosa	.	.	+	+	+	+	1	+	+	+	1	1	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	+	.	.	.	.	.	+	.
Euphorbia inaequilatera	+	.	+	+	+	+	+	+	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ceratotheca triloba	.	.	.	.	+	.	+	.	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Waltheria indica	+	+	+	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Aptosimum procumbens	.	+	+	.	+	+	.	.	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.
Tapinanthus species	r	.	.	+	.	.	.	.	+	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Eragrostis nindensis	.	.	.	.	+	+	.	.	.	.	1	+	.	.	.	.	+	.	.	+	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.
Berkheya species	+	+	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sida rhombifolia	+	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Zornia milneana	.	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Phyllanthus loandensis	.	.	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Species group C (Diagnostic species of Sub-community 1.2)																																				
Aloe greatheadii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Withania somnifera	.	.	.	.	.	+	.	.	.	.	+	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Aloe marlothii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Solanum lichtensteinii	.	.	.	.	.	.	+	.	.	.	+	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.
Dicoma anomala	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Species group D (Diagnostic species of Sub-community 1.3)																																				
Sida dregei	.	.	.	.	+	.	+	.	.	.	.	.	.	+	+	.	.	.	.	+	.	.	+	+	.	.	+	1	+	+	+	.	+	+	.	+
Ipomoea obscura	.	.	.	.	+	.	.	.	.	.	.	.	.	.	+	.	.	.	+	+	+	+	+	.	+	.	.	+	+	+	+	+	+	+	+	.
Phyllanthus parvulus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+	.	+	+	+	+	+
Ipomoea ommaneyi	.	.	.	.	.	.	.	.	1	.	.	.	.	.	1	.	.	.	.	.	.	.	.	a	+	.	+	1	a	.	.	.	.	.	.	.
Ipomoea oblongata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+	1	1
Digitaria setifolia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	+	+
Cyphostemma simulans	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	+	.	+
Ipomoea papilio	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	1	1	.	.	.	+	.	.	.	.
Heliotropium strigosum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	1	.	.	.
Rhynchosia nitens	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	+

Communities 2–5.2:

Site number							1	1	1	1	1	1																																						
	4	4	4	4	9	9	0	0	0	0	0	0					1	7	7	7	7	5	5	5	5	6	6	7	7	7	7	7	7	9	9			1	6	6	5	5	5	5	6	6	6	6	7	7
	1	1	2	2	9	9	1	1	2	2	3	3	3	3	9	9	5	2	2	5	5	3	3	4	4	2	2	6	6	7	7	8	8	4	4	7	7	5	0	0	0	0	8	8	5	5	8	8	1	1
Relevé number					1	1	2	2	2	2	2	2						1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1				1	1			1	1	1	1	1	1	1	1
	8	8	8	8	9	9	0	0	0	0	0	0			1	1	2	4	4	4	4	0	0	0	0	2	2	5	5	5	5	5	5	8	8	1	1	3	1	1	9	9	1	1	2	2	3	3	4	4
	0	1	2	3	6	7	0	1	2	3	4	5	5	6	7	8	9	2	3	8	9	4	5	6	8	2	3	0	1	2	3	4	5	6	7	3	4	0	8	9	8	9	4	5	8	9	4	5	0	1
Number of species	6	5	5	6	5	6	5	6	4	5	6	6	6	5	5	5	5	3	4	5	4	4	4	5	4	5	4	3	5	3	4	5	3	4	5	4	5	5	4	4	4	3	4	3	2	2	4	4	3	3
per relevé	0	2	3	6	7	5	6	1	5	9	4	1	5	2	5	0	3	7	2	4	4	6	2	1	4	0	6	4	4	3	6	1	3	0	0	2	0	5	3	2	2	9	0	0	8	5	5	0	2	5
Communities	2												3									4														5.1					5.2									
Species group A (Diagnostic species of Community 1)																																																		
Aristida congesta s. barbicollis	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	1	+	.	+	+	.	.	+	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Brachiaria nigropedata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	a	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Oxalis obliquifolia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+	.	+	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Raphionacme hirsuta	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Eragrostis superba	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Crabbea angustifolia	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Heliotropium steudneri	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	1	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Anthephora pubescens	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Commelina africana	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	+	1	.	.	+	.	.	+	+	.	.	+	.	.	.	.	.
Thesium utile	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ptycholobium plicatum	.	.	.	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Blepharis integrifolia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	+	.	.	.	.	.	.	.	.	+	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Species group B (Diagnostic species of Sub-community 1.1)																																																		
Hermannia tomentosa	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Euphorbia inaequilatera	.	.	+	+	.	+	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	+	.	+
Ceratotheca triloba	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.
Waltheria indica	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Aptosimum procumbens	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Tapinanthus species	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Eragrostis nindensis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Berkheya species	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sida rhombifolia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	+	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Zornia milneana	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Phyllanthus loandensis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Species group C (Diagnostic species of Sub-community 1.2)																																																		
Aloe greatheadii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Withania somnifera	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Aloe marlothii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Solanum lichtensteinii	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dicoma anomala	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Species group D (Diagnostic species of Sub-community 1.3)																																																		
Sida dregei	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ipomoea obscura	+	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	+	+	+	+	.	.	+	+	.	.	.	.	.	+	.	.	.	.	+	.	.	.	.	.	+	.	.	+	.
Phyllanthus parvulus	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ipomoea ommaneyi	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ipomoea oblongata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Digitaria setifolia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cyphostemma simulans	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ipomoea papilio	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Heliotropium strigosum	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rhynchosia nitens	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.

Table 4.1 (continued)

Relevé no.	1	2	3	4	19	20	31	220	57	56	62	63	54	55	60	61	66	67	130	131	136	137	58	59	126	127	158	159	160	161	168	169	170	171	172	173
Communities	1.1												1.2										1.3													
Species group E (Diagnostic species of Community 2)																																				
Combretum imberbe	1	b	.	.	.	.	.	.	+	+	1	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.
Clerodendrum suffruticosum v. *suffruticosum*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sclerocarya birrea	.	1	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Combretum hereroense	.	+	a	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
**Tagetes minuta*	.	.	.	+	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dombeya rotundifolia	.	+	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cymbopogon nardus	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+	1	+	.	.	.	+	.	.	a	+	.	.	.	.	.	.	.	.	.	.
Pappea capensis	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Berchemia zeyheri	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Striga asiatica	.	+	.	.	.	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Vitex zeyheri	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Gymnosporia buxifolia	1	+	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Andropogon chinensis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Combretum apiculatum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ozoroa paniculosa	.	.	.	.	.	.	+	+	.	.	+	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.
Pogonarthria squarrosa	.	.	.	.	.	.	+	a	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Tarchonanthus camphoratus	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Polygala sphenoptera	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Chamaecrista mimosoides	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.
Vigna frutescens	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Ocimum americanum v. *americanum*	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Species group F																																				
Aristida congesta s. *congesta*	1	+	+	.	a	a	.	.	+	+	.	.	a	1	+	+	+	+	b	1	1	+	+	+	+	+	.	.	+	1	.	.	.	.	.	.
Melinis repens	+	+	+	+	+	+	+	1	+	+	.	.	+	+	.	.	+	+	1	+	.	+	.	+	.	.	1	+	+	.	1	+	+	+	.	.
Indigofera daleoides	+	+	a	b	1	+	1	b	1	1	1	1	.	1	+	.	.	.	+	.	.	.	1	+	.	.	+	+	1	.	+	+	.	.	+	+
Acacia caffra	a	.	.	.	.	.	b	b	+	.	.	.	1	+	a	+	1	a	a	+	1	+	.	.	.	.	.	.	.	.	a	b	.	1	.	.
Eustachys paspaloides	+	.	.	.	.	.	.	.	.	.	+	.	.	+	1	+	+	+	.	+	.	.	.	.	.	.	.	.	.	.	+	+	+	+	+	+
Chascanum hederaceum	1	+	+	+	1	+	+	+	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	+	+	.	+	.	+	.	+	+	.	.	+	.
Jatropha zeyheri	.	.	+	+	+	+	+	.	+	+	+	.	.	.	+	.	+	.	.	.	.	.	+	+	.	.	.	.	.	.	+	1	+	1	1	.
Elephantorrhiza elephantina	.	.	.	.	+	+	+	+	.	.	1	+	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	.	+	+	.	a	1	1
Indigofera heterotrich	.	.	+	+	+	.	.	.	.	.	.	1	.	.	+	+	.	+	.	.	.	.	.	+	.	.	.	.	.	+	.	1	+	+	.	+
Barleria macrostegia	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	+	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	+	+
Species group G (Diagnostic species of Community 3)																																				
Sporobolus nitens	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pavonia senegalensis	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Eragrostis lehmanniana	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Eragrostis racemosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Indigofera holubii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+	1	1	.	.	.	1	.	.	.	.	.	.	.	.	.	.
Cadaba termitaria	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Boerhavia diffusa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pupalia lappacea	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Flueggea virosa	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Melhania prostrata	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Relevé no.	80	81	82	83	196	197	200	201	202	203	204	205	5	6	17	18	29	142	143	148	149
Communities	2												3								
Species group E (Diagnostic species of Community 2)																					
Combretum imberbe	1	.	1	a	+	1	b	a	+	.	+	1	.	+	.	.	.	.	.	.	.
Clerodendrum suffruticosum v. *suffruticosum*	1	a	.	.	.	a	.	.	a	a	a	3	.	.	.	.	.	.	.	.	.
Sclerocarya birrea	.	+	+	.	.	a	.	+	b	+	+	.	+	.	.	.	.	+	.	.	.
Combretum hereroense	+	+	+	3	+	+	.	.	.	+	.	+	.	+	.	.	.	.	.	+	.
**Tagetes minuta*	1	+	.	.	+	1	1	+	.	.	1	+	.	.	.	+	.	.	.	.	.
Dombeya rotundifolia	+	.	.	+	+	+	.	+	+	+	.	1	.	.	.	.	.	.	.	.	.
Cymbopogon nardus	a	.	a	.	+	+	.	.	.	.	1	+	.	.	.	.	.	.	.	+	.
Pappea capensis	b	.	.	+	+	a	.	.	.	1	+	.	+	.	.	.	.	.	.	.	a
Berchemia zeyheri	+	+	+	.	.	.	.	.	.	+	+	1	1	+	.	.	.	.	.	.	.
Striga asiatica	+	+	+	.	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Vitex zeyheri	.	+	+	+	.	+	+	.	.	.	+	+	.	.	.	.	.	.	.	.	.
Gymnosporia buxifolia	+	+	.	.	.	+	.	+	+	+	+	.	1	+	.	+	.	.	+	+	+
Andropogon chinensis	.	.	.	.	+	1	a	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Combretum apiculatum	.	.	.	.	+	+	+	b	.	.	.	.	.	.	.	.	.	1	+	.	.
Ozoroa paniculosa	+	+	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pogonarthria squarrosa	.	.	.	.	.	.	+	+	.	.	+	1	.	.	.	.	.	.	.	.	.
Tarchonanthus camphoratus	1	.	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.
Polygala sphenoptera	.	.	.	.	.	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.
Chamaecrista mimosoides	.	.	.	.	.	.	+	+	.	.	+	.	.	.	.	.	.	.	.	.	.
Vigna frutescens	.	.	.	.	.	.	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.
Ocimum americanum v. *americanum*	.	.	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Species group F																					
Aristida congesta s. *congesta*	.	.	.	.	.	.	1	+	+	+	.	+	+	.	.	.	.	.	.	+	.
Melinis repens	.	.	.	+	+	.	+	+	.	+	+	+	.	.	.	.	.	.	.	.	.
Indigofera daleoides	+	.	.	.	+	.	a	a	.	.	1	a	.	.	+	.	+	.	.	.	.
Acacia caffra	+	a	.	.	+	+	1	+	1	+	+	+	.	.	.	.	.	.	.	.	+
Eustachys paspaloides	+	+	.	.	+	+	+	+	1	+	+	+	.	.	.	.	.	.	.	.	.
Chascanum hederaceum	.	+	.	.	+	.	+	+	.	.	.	+	.	.	.	.	.	.	.	.	.
Jatropha zeyheri	.	.	.	.	+	.	+	.	.	.	+	+	.	.	.	.	.	.	.	.	.
Elephantorrhiza elephantina	.	.	.	.	+	+	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.
Indigofera heterotrich	.	.	+	.	1	1	.	+	.	.	+	+	.	.	.	.	.	.	.	.	.
Barleria macrostegia	+	+	.	.	.	.	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.
Species group G (Diagnostic species of Community 3)																					
Sporobolus nitens	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	+	+	+	+
Pavonia senegalensis	.	.	.	.	.	.	.	.	.	.	.	+	a	.	.	.	.	.	1	+	a
Eragrostis lehmanniana	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	a	1	1	+
Eragrostis racemosa	.	.	.	+	.	.	.	.	.	.	.	.	b	1	.	.	.	+	+	.	.
Indigofera holubii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	a	+	1	.
Cadaba termitaria	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	a	.	+	1
Boerhavia diffusa	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	1	+	+	.
Pupalia lappacea	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	+	+	.	+
Flueggea virosa	.	.	+	1	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	+
Melhania prostrata	+	.	.	.	.	+	.	.	.	.	.	.	+	.	.	.	.	.	+	+	.

Relevé no.	104	105	106	108	122	123	150	151	152	153	154	155	186	187	13	14	30	118	119	98	99	114	115	128	129	134	135	140	141
Communities	4														5.1					5.2									
Species group E (Diagnostic species of Community 2)																													
Combretum imberbe	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Clerodendrum suffruticosum v. *suffruticosum*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sclerocarya birrea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Combretum hereroense	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.
**Tagetes minuta*	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	.	+	.	.	+	.	.	.	.	.
Dombeya rotundifolia	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cymbopogon nardus	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Pappea capensis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.
Berchemia zeyheri	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Striga asiatica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Vitex zeyheri	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Gymnosporia buxifolia	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Andropogon chinensis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Combretum apiculatum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ozoroa paniculosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pogonarthria squarrosa	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Tarchonanthus camphoratus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Polygala sphenoptera	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Chamaecrista mimosoides	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Vigna frutescens	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ocimum americanum v. *americanum*	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Species group F																													
Aristida congesta s. *congesta*	.	+	+	+	+	+	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Melinis repens	.	+	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Indigofera daleoides	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	1	+	.	.	.	.	.	.	.	.	.	.	.	.
Acacia caffra	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Eustachys paspaloides	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Chascanum hederaceum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Jatropha zeyheri	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Elephantorrhiza elephantina	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Indigofera heterotrich	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.
Barleria macrostegia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Species group G (Diagnostic species of Community 3)																													
Sporobolus nitens	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Pavonia senegalensis	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Eragrostis lehmanniana	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Eragrostis racemosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	+	.	.
Indigofera holubii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cadaba termitaria	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Boerhavia diffusa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Pupalia lappacea	+	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Flueggea virosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Melhania prostrata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Table 4.1 (continued)

Relevé no.								2											1	1	1	1			1	1	1	1	1	1	1	1	1	1	1	1					1	1	2	2	2	2	2	2						1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1				1	1			1	1	1	1	1	1	1	1
					1	2	3	2	5	5	6	6	5	5	6	6	6	6	3	3	3	3	5	5	2	2	5	5	6	6	6	6	7	7	7	7	8	8	8	8	9	9	0	0	0	0	0	0			1	1	2	4	4	4	4	0	0	0	0	2	2	5	5	5	5	5	5	8	8	1	1	3	1	1	9	9	1	1	2	2	3	3	4	4
	1	2	3	4	9	0	1	0	7	6	2	3	4	5	0	1	6	7	0	1	6	7	8	9	6	7	8	9	0	1	8	9	0	1	2	3	0	1	2	3	6	7	0	1	2	3	4	5	5	6	7	8	9	2	3	8	9	4	5	6	8	2	3	0	1	2	3	4	5	6	7	3	4	0	8	9	8	9	4	5	8	9	4	5	0	1
Communities	1.1												1.2										1.3														2												3									4														5.1					5.2									
Species group H (Diagnostic species of Community 4)																																																																																						
Acacia erioloba	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	a	a	1	1	b	b	a	a	.	.	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Commelina benghalensis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+	+	+	1	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
Portulaca quadrifida	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	+	1	b	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lycium cinereum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	.	.	.	.	+	+	1	+	.	.	.	.	.	.	+	.	.	.	.	+	.	.	.
Cynodon dactylon	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	+	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cenchrus ciliaris	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	+	1	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	+	+	1	a	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.
Leucas capensis	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Gisekia pharnacioides	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
**Chenopodium album*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	+	.	.	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
Sida cordifolia	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Species group I																																																																																						
Grewia monticola	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	+	+	+	.	+	+	+	.	+	.	+	.	.	.	.	+	.	.	.	.	.	.	1	+	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hermbstaedtia linearis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+	.	.	.	+	+	.	.	.	.	.	.	.	.	+	+	+	+	+	+	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Ximenia americana	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	+	+	+	.	.	+	+	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.
Species group J																																																																																						
Panicum maximum	1	1	+	+	+	.	.	.	.	.	.	.	3	1	a	3	+	.	.	.	+	a	.	.	.	+	.	.	.	.	.	.	.	+	+	1	.	.	.	.	.	+	.	.	+	.	+	+	+	.	.	+	+	.	+	1	b	a	1	+	+	3	1	3	3	a	3	3	a	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Tragus berteronianus	.	+	+	+	+	+	.	+	.	.	.	+	.	.	+	+	+	+	+	+	+	+	+	+	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	+	+	.	.	.	+	+	+	+	+	+	+	1	1	1	.	+	+	+	.	.	+	.	+	1	.	+	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Schmidtia pappophoroides	.	+	1	1	+	+	a	a	+	+	.	+	.	.	+	+	.	.	+	+	.	.	1	+	.	.	1	1	.	+	a	+	1	.	+	a	+	.	.	.	+	.	1	+	+	+	+	+	.	.	+	+	.	.	.	.	.	.	.	+	+	.	.	+	+	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rhus leptodictya	+	1	+	a	+	.	.	.	.	.	.	.	.	1	.	1	.	.	1	1	+	+	+	.	+	.	.	.	.	.	+	+	+	+	1	1	+	+	+	+	+	+	.	.	+	1	+	.	.	+	+	+	+	.	+	+	+	.	.	.	.	.	+	.	.	.	+	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Monsonia angustifolia	+	+	+	+	.	.	+	+	+	.	+	.	+	1	.	.	+	.	+	.	+	+	+	.	.	+	.	.	+	+	.	.	.	.	.	.	+	+	1	+	.	+	.	+	.	.	.	.	+	+	+	1	+	+	.	.	.	.	1	.	.	+	+	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	+	.	.
Kyphocarpa angustifolia	.	+	.	.	.	+	.	.	.	.	.	.	.	.	1	+	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	+	.	.	.	.	.	1	+	+	+	.	+	1	+	+	+	+	+	+	.	.	+	+	1	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Phyllanthus incurvus	+	.	.	.	.	.	+	.	+	+	+	.	.	+	.	.	+	+	+	+	+	+	.	+	.	.	.	.	.	.	1	.	+	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	+	+	.	.	.	+	+	.	.	+	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
Hirpicium bechuanense	.	.	.	.	.	.	.	.	1	1	+	.	.	+	+	.	.	.	+	+	.	.	1	+	+	a	+	1	+	.	+	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	1	+	.	+	.	+	.	+	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Evolvulus alsinoides	+	.	+	+	+	+	+	+	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	+	.	.	.	.	.	+	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	+	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Abutilon angulatum	.	.	.	.	+	.	.	.	.	+	.	.	.	.	+	+	.	.	.	+	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	+	.	+	.	.	.	.	+	.	.	+	+	.	.	.	.	+	+	+	.	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cucumis zeyheri	.	.	.	+	.	+	.	.	+	+	+	+	.	+	.	.	+	.	+	+	.	.	.	+	.	.	+	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	+	.	+	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
Rhus pyroides	1	+	+	.	.	.	+	.	+	+	.	.	a	+	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	1	+	+	.	.	.	+	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Peltophorum africanum	.	+	1	a	.	+	+	a	.	.	.	.	.	.	.	.	.	.	.	1	+	a	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	+	+	.	.	.	.	.	1	.	.	1	1	a	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Nidorella anomala	.	.	.	.	.	.	.	+	+	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	+	1	+	.	.	.	+	+	.	.	.	.	.	.	.	+	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	+	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.
Nidorella resedifolia s. *resedifolia*	.	.	.	+	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	+	.	+	.	+	+	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ledebouria revoluta	+	.	+	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	+	+	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	+	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Eragrostis biflora	.	.	.	1	.	.	.	.	.	.	.	.	+	+	+	+	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	1	.	.	.	.	.	.	.	+	+	+	.	+	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.
Species group K (Diagnostic species of Community 5)																																																																																						
Brachiaria eruciformis	+	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	a	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	+	.	.	.	.	.	.	b	a	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	3	3	3	b	3	b	3	1	a	b	1	+	+	a	1
Ischaemum afrum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+	+	+	+	b	a	+	b	1	1	+	+
Setaria incrassata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	a	1	+	.	.	1	+	a	1	1	3	+	+	b	b
Ipomoea gracilisepala	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	+	+	1	+	.	.	+	.	.	+
Orthosiphon amabilis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	a	+	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	+	1	.	+	+	1	+	+
Crabbea hirsuta	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+	+	.	.	.	1	+	+	.
Vernonia oligocephala	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	+	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	+	.	1	+	.	.	+	.	+	.
Asparagus laricinus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	1	.	+	1	.	.	+	.
Eragrostis curvula	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	+	+	+	+	.	.	.	.	.	+	+
Species group L (Diagnostic species of Community 5.1)																																																																																						
Diospyros lycioides	.	.	.	.	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.	+	.	.	+	1	.	.	.	.	+	+	1	a	.	.	+	.	.	.	.	+	.	.
Panicum schinzii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+	+	.	.	.	.	.	.	.	.	.	.	.	.
Eragrostis inamoena	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	+	.	.	+	+	.	.	.	.	.	.
Sorghum versicolor	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.

Table 4.1 (continued)

Relevé no.								2											1	1	1	1			1	1	1	1	1	1	1	1	1	1	1	1					1	1	2	2	2	2	2	2						1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1				1	1			1	1	1	1	1	1	1	1
					1	2	3	2	5	5	6	6	5	5	6	6	6	6	3	3	3	3	5	5	2	2	5	5	6	6	6	6	7	7	7	7	8	8	8	8	9	9	0	0	0	0	0	0			1	1	2	4	4	4	4	0	0	0	0	2	2	5	5	5	5	5	5	8	8	1	1	3	1	1	9	9	1	1	2	2	3	3	4	4
	1	2	3	4	9	0	1	0	7	6	2	3	4	5	0	1	6	7	0	1	6	7	8	9	6	7	8	9	0	1	8	9	0	1	2	3	0	1	2	3	6	7	0	1	2	3	4	5	5	6	7	8	9	2	3	8	9	4	5	6	8	2	3	0	1	2	3	4	5	6	7	3	4	0	8	9	8	9	4	5	8	9	4	5	0	1
Communities	1.1												1.2										1.3														2												3									4														5.1					5.2									
Species group M																																																																																						
Solanum panduriforme	1	+	.	.	1	+	+	+	+	+	.	+	1	+	.	a	+	+	.	+	.	+	+	.	+	+	.	.	.	.	.	+	.	.	.	.	.	.	.	+	.	+	+	+	+	+	a	a	+	.	+	+	+	.	+	+	+	+	.	+	+	1	1	1	a	a	a	+	1	.	.	.	+	+	+	+	.	.	.	.	.	.	.	.	.	.
Aristida canescens	.	+	+	+	+	+	a	+	+	+	+	+	+	.	+	+	+	+	+	a	+	a	.	+	.	+	.	.	+	+	b	+	+	+	+	+	.	+	.	+	+	.	.	+	.	.	+	+	1	1	a	+	a	a	a	+	+	+	.	.	+	1	+	.	.	+	1	.	.	.	.	.	+	1	+	.	.	.	.	.	.	.	.	+	.	.
Pentarrhinum insipidum	+	+	.	+	.	.	.	.	.	+	.	.	+	+	+	.	+	.	+	.	+	+	.	.	+	.	.	+	.	.	+	.	+	+	.	+	+	.	+	1	+	+	1	1	+	+	+	+	+	+	.	.	.	+	.	.	+	+	+	1	1	+	.	.	.	.	.	+	.	+	+	.	+	.	.	+	+	+	.	.	.	.	.	.	.	.
Acacia robusta	1	.	.	.	.	.	.	.	.	.	.	.	.	.	a	a	.	a	.	+	a	1	1	.	.	.	.	.	.	.	.	.	+	+	.	.	1	1	.	+	+	1	.	.	1	1	+	+	.	b	1	+	+	+	a	1	1	.	.	+	.	.	a	.	.	.	.	.	.	.	.	1	a	a	.	+	.	.	.	.	.	.	.	.	.	.
Pavonia burchellii	+	.	+	+	+	.	.	.	.	+	.	.	.	.	+	+	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	+	+	+	+	.	.	.	+	.	.	+	.	+	+	.	+	+	+	+	.	+	.	+	+	+	+	+	.	+	+	+	.	.	+	.	+	.	.	+	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.
Euclea undulata	+	+	+	a	+	.	.	.	.	.	.	.	.	+	.	+	.	1	.	+	+	+	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	+	.	.	3	+	+	.	+	+	1	+	a	+	+	a	+	1	a	+	1	.	.	.	.	.	1	.	.	.	.	+	.	.	.	.	.	.	1	1	.	.	.	.	.	.	.	.	.	.
Ruellia cordata	1	.	.	.	.	+	.	+	.	.	.	.	+	+	.	.	.	.	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	+	1	.	+	+	+	+	1	.	1	1	1	1	+	.	.	.	.	.	+	.	.	1	+	+	+	.	.	+	.	.	+	+	.	.	.	.	.	.	.	.
**Bidens bipinnata*	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	+	+	.	+	.	+	+	1	+	+	+	+	.	.	+	.	+	+	.	.	.	.	.	+	+	.	1	+	.	.	+	+	+	.	+	+	+	.	.	.	.	.	.	.	.	.
Setaria verticillata	.	.	.	a	+	.	.	+	.	.	.	.	.	+	.	.	+	.	.	+	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	.	+	+	b	+	+	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	+	+	.	.	.	.	.	.	+	.	.	.
Ehretia rigida	.	+	.	.	+	.	.	.	.	.	.	.	.	.	+	+	.	.	+	+	+	+	.	.	+	.	.	.	.	.	.	.	.	+	.	+	+	.	.	+	.	.	.	.	+	.	.	.	+	+	+	.	+	.	+	+	+	+	+	.	.	+	.	+	.	.	.	.	.	.	.	.	.	+	+	.	+	.	.	.	.	.	.	.	.	.
Species group N (Diagnostic species of Community 5.2)																																																																																							
Aspilia mossambicensis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+	a	1	.	+	1	+	+	1
Dichanthium annulatum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+	.	+	.	+	+	b	.	.
Urelytrum agropyroides	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	a	a	.	.	a	b	.	.	.	1
Convolvulus sagittatus	.	.	.	.	.	.	.	+	.	.	.	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	+	+	+	1	+
Eragrostis chloromelas	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+	.	.	.	+
Senecio harveianus	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	+	+	+	+	.	.	+
Hibiscus cannabinus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.	.	.	.	+	+
Aristida bipartita	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	.	+	1	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	+	+	.	.
Ziziphus zeyheriana	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	+	.
Ursinia nana	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.

Table 4.1 (continued)

Relevé no.	1	2	3	4	19	20	31	220	57	56	62	63	54	55	60	61	66	67	130	131	136	137	58	59	126	127	158	159	160	161	168	169	170	171	172	173	80	81	82	83	196	197	200	201	202	203	204	205	5	6	17	18	29	142	143	148	149	104	105	106	108	122	123	150	151	152	153	154	155	186	187	13	14	30	118	119	98	99	114	115	128	129	134	135	140	141
Communities	1.1												1.2										1.3														2												3									4														5.1					5.2									
Species group O																																																																																							
Acacia tortilis	.	+	1	b	1	a	.	+	+	a	+	+	a	1	1	b	+	+	1	a	a	b	+	.	+	b	1	+	1	a	+	+	a	1	1	a	1	.	1	1	.	.	+	+	1	+	+	.	b	a	b	b	b	+	+	1	a	b	a	1	1	1	a	b	a	b	+	a	a	b	a	+	a	a	a	a	a	a	+	+	a	a	+	+	1	+
Grewia flava	+	+	+	1	a	+	.	.	1	1	.	1	a	1	+	+	+	1	1	a	1	a	+	.	1	a	+	1	+	1	+	+	+	+	.	+	+	+	+	1	.	.	.	+	+	1	.	+	1	1	a	a	1	+	+	1	1	+	+	+	+	1	+	+	+	+	1	1	+	+	+	+	1	+	+	+	1	1	+	+	.	.	+	+	+	+
Dichrostachys cinerea	1	b	.	.	a	b	+	+	+	+	+	+	1	+	1	1	1	+	+	1	+	.	+	+	+	+	+	.	.	.	+	+	+	+	.	+	a	1	+	1	a	3	b	a	3	b	b	3	a	b	a	1	+	b	3	b	b	+	1	1	1	1	1	+	+	+	+	+	+	+	+	+	+	+	b	+	b	a	1	1	.	.	.	.	.	+
Digitaria eriantha	+	+	.	.	.	.	1	b	a	1	.	1	.	b	+	+	a	a	a	+	a	+	.	b	a	a	1	b	b	a	+	+	a	+	+	+	1	1	1	1	1	b	a	a	1	b	+	+	1	+	1	+	.	.	.	+	+	.	.	+	+	+	a	+	a	.	.	1	1	.	+	+	+	1	1	+	+	.	+	+	.	.	1	1	1	1
Eragrostis rigidior	1	1	b	b	+	+	b	3	b	b	+	.	+	+	1	+	1	+	+	1	+	1	a	+	+	+	+	+	+	1	+	+	1	.	+	1	1	b	+	.	+	+	3	b	+	+	1	b	.	+	1	+	1	+	1	+	1	+	a	a	b	1	b	+	1	a	1	.	+	a	1	.	.	.	b	.	+	.	.	.	.	.	+	.	+	.
Cymbopogon pospischilii	1	1	.	.	1	1	1	+	a	+	1	+	.	+	a	1	a	a	1	1	a	1	a	3	a	1	a	1	b	b	a	+	1	1	1	1	+	+	+	+	a	a	1	1	1	1	a	1	1	+	.	.	+	.	.	.	.	.	.	+	+	.	.	.	.	.	.	+	.	.	+	.	.	+	+	1	a	1	+	1	.	+	a	+	1	1
Heteropogon contortus	3	a	+	+	.	+	1	1	1	+	+	a	a	3	+	+	+	+	+	+	+	+	.	+	a	1	1	b	1	1	+	b	+	+	1	+	1	1	a	a	3	b	a	b	b	a	b	3	+	.	+	.	.	.	.	.	.	1	b	a	1	.	.	.	.	.	.	1	+	+	1	.	.	+	.	.	.	.	.	.	.	.	1	+	.	+
Urochloa mosambicensis	+	+	+	b	+	+	.	.	+	+	a	.	1	+	+	a	+	1	.	1	1	b	3	+	+	.	1	.	.	+	.	.	a	.	+	+	.	.	.	.	+	+	+	.	.	.	+	+	+	1	+	1	1	.	+	+	a	3	a	1	1	a	1	1	a	+	.	1	b	b	b	+	+	.	+	+	1	.	.	.	.	.	+	+	.	.
Ziziphus mucronata	a	1	+	+	+	+	.	+	+	+	.	.	a	a	+	+	+	+	+	+	+	+	+	.	.	+	.	+	+	1	.	.	.	.	.	1	+	.	+	b	+	+	+	.	.	+	.	.	.	+	1	+	+	+	+	+	+	+	+	1	.	.	.	1	+	+	+	+	+	+	+	+	+	+	1	1	+	1	.	.	+	.	.	.	+	.
**Schkuhria pinnata*	+	+	+	1	+	+	.	+	+	+	+	+	+	1	.	.	+	+	+	+	.	.	+	+	.	+	.	.	.	.	.	+	+	.	.	.	.	.	1	+	+	+	+	+	.	.	+	.	1	1	a	a	1	.	.	.	.	.	+	+	+	+	+	.	+	1	.	.	.	+	+	a	a	1	1	1	+	+	+	+	1	+	+	+	1	1
Panicum coloratum	a	+	.	.	+	+	.	+	+	+	.	+	.	+	+	1	1	+	+	+	1	1	+	1	+	1	+	+	1	1	+	1	1	+	+	+	1	a	+	+	+	+	1	+	+	+	.	+	+	+	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	+	+	+	+	.	.	.	.	1	a	.	+	+	1	a	1
Asparagus suaveolens	+	+	+	+	+	.	.	.	.	+	.	.	+	+	.	+	+	+	+	+	+	+	+	.	+	.	.	.	+	.	.	.	.	.	+	+	+	.	+	+	.	.	.	.	+	+	.	+	+	+	+	+	+	+	+	+	+	+	+	+	+	.	.	.	+	.	.	+	+	+	+	+	1	1	+	.	+	+	.	.	+	+	.	+	+	.
Tephrosia purpurea	+	+	+	+	+	a	.	+	.	+	.	.	.	1	.	.	+	+	+	+	.	.	+	.	1	.	+	+	+	+	.	.	.	.	+	.	.	1	+	.	+	.	.	+	.	+	+	+	+	.	.	+	.	+	.	+	+	.	+	+	+	.	.	+	.	.	+	.	.	+	1	+	+	.	.	+	+	+	+	+	+	.	+	1	.	.
Lantana rugosa	1	1	+	+	+	+	+	+	.	.	+	.	.	+	+	1	+	.	+	1	+	+	+	.	.	.	.	+	+	1	+	+	.	.	.	.	+	+	+	+	.	+	+	.	+	+	+	1	+	.	+	.	+	+	+	.	+	+	+	+	.	.	.	.	.	.	.	.	.	+	.	1	.	+	.	+	+	+	+	.	.	.	.	.	.	.
Acacia nilotica	.	.	.	+	.	.	.	.	.	.	+	.	b	a	+	1	a	1	a	1	.	+	+	.	+	+	+	+	.	.	+	1	.	+	.	.	a	.	+	1	+	+	+	.	+	+	+	b	.	.	1	.	.	+	+	a	a	.	+	.	.	a	1	+	+	.	1	.	+	.	.	b	a	.	+	.	.	.	.	.	a	a	+	.	.	.
Acacia karroo	1	.	a	.	.	.	.	.	a	1	a	a	+	+	.	a	.	+	.	.	+	+	1	.	1	a	.	1	.	1	.	.	.	+	.	.	1	1	+	+	.	.	.	.	+	.	.	.	.	+	.	.	+	.	.	.	.	+	.	1	.	+	+	.	.	.	.	+	+	.	.	1	+	1	1	+	a	a	a	1	.	+	1	1	a	a
Hibiscus trionum	+	.	.	.	+	+	.	.	.	+	+	+	.	+	.	.	+	+	+	+	.	.	+	.	+	.	.	+	.	.	.	.	.	.	.	.	+	+	+	+	+	+	+	+	.	+	.	.	+	+	+	.	.	.	.	.	.	.	+	+	.	.	+	.	.	.	.	+	.	+	.	+	.	+	+	+	+	+	+	+	+	+	+	+	.	+
Themeda triandra	a	b	.	.	+	+	.	+	.	+	+	.	.	b	+	+	+	+	.	.	1	.	.	+	3	+	+	.	a	a	+	b	1	3	b	a	.	+	.	.	+	.	.	+	+	.	+	.	1	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	+	.	.	+	.	.	+	+	.	+
Enneapogon cenchroides	.	+	.	.	.	.	+	.	+	+	+	.	+	.	.	+	.	.	.	+	+	+	.	.	.	1	+	.	.	.	.	+	+	.	.	.	.	.	.	1	.	+	.	.	.	+	1	+	+	.	b	b	+	+	.	+	+	+	.	.	+	.	.	.	.	+	+	+	+	.	.	a	1	+	+	+	.	+	.	.	.	.	+	+	.	.
Bothriochloa insculpta	1	+	.	.	.	.	.	.	+	1	+	.	1	1	.	+	+	+	.	+	.	+	.	.	.	+	.	.	.	.	.	.	.	+	.	.	.	.	+	+	.	+	.	+	+	+	.	.	+	a	.	.	+	.	.	.	.	+	1	1	+	.	.	.	.	.	.	.	.	+	b	+	+	1	+	+	a	+	1	1	+	.	.	.	.	.
Enneapogon scoparius	+	.	.	.	.	.	.	.	+	+	+	+	.	+	1	a	.	+	.	.	+	.	+	+	.	+	.	+	.	+	.	.	.	.	.	+	a	+	b	3	1	a	+	1	a	+	1	1	+	+	.	1	.	.	.	.	+	.	.	+	.	.	.	.	+	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	+	+	.	+
Chloris virgata	.	.	.	+	+	.	.	.	+	+	.	.	+	.	.	.	+	+	.	+	+	+	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+	.	.	.	b	.	a	+	+	+	.	+	+	+	1	.	+	+	.	+	+	.	.	1	1	+	+	+	+	+	.	.	+	.	.	.	.	.
Corchorus asplenifolius	+	.	.	+	.	+	+	1	+	.	.	.	.	+	.	.	.	.	+	.	.	.	.	+	.	.	.	.	.	+	+	.	.	+	+	+	.	.	.	.	+	.	+	+	+	+	+	.	.	.	.	+	.	+	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	+	+	+	.	.	.	.	.	.	+	+	.	.	+	+	1	+
Sida spinosa	+	.	.	.	+	+	.	.	+	+	+	.	+	+	.	.	+	+	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+	+	+	+	.	+	+	.	.	.	+	.	+	+	+	+	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	+	+	+	+	.	.	.	+	+	.	.	.	.
Hibiscus pusillus	.	+	+	.	+	1	.	+	.	.	.	.	.	.	+	+	.	+	.	.	.	+	+	+	+	+	.	+	+	+	.	.	+	+	.	+	.	.	.	.	+	.	.	+	.	.	+	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	+	.	+	+	+	.	.	.	.	.	.	.	.	+	+	+	+
Rhynchosia minima	+	1	.	+	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+	a	a	a	+	1	1	a	1	+	+	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	+	+	1	+	.	1	.	.	.	+	+
**Zinnia peruviana*	+	1	+	b	+	.	.	+	.	.	+	.	+	.	.	.	.	+	.	.	+	.	.	.	.	.	.	+	.	.	.	.	+	.	.	.	+	.	+	1	.	+	+	.	.	.	1	+	+	.	1	+	+	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	+	1	.	+	1	1	.	.	.	.	.	.	.	.	.
Aristida diffusa	+	1	+	.	+	+	.	.	+	.	+	+	.	+	+	.	.	+	.	.	+	.	.	.	.	.	.	+	.	+	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	a	b	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	+	+	.	+	.	.	+	+
**Achyranthes aspera*	.	.	.	+	+	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	+	+	1	+	a	+	.	+	.	+	.	a	+	+	1	1	.	.	.	.	+	.	+	1	+	+	.	.	+	.	.	.	.	.
Acalypha indica	.	+	.	+	.	.	.	.	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	1	+	+	+	+	.	.	+	.	1	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+	.	.	.	+	+	+	.	+	+	.	.
Fingerhuthia africana	.	.	.	.	.	.	.	.	.	.	b	b	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	+	a	1	+	1	+	+	+	.	+	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	+	.	.	.	.	+	+	.	.	1	1	1	+
Leucas martinicensis	.	.	.	1	+	+	.	.	.	+	.	.	+	+	.	+	+	+	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	+	.	.	.	.	1	+	1	.	1	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	+	+	1	+	+	+	+	.	.	+	+	.	.	.	.
Kohautia amatymbica	.	+	.	+	+	.	+	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	1	1	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	+	+	+	.	+
Indigo charliriana v. *charliriana*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	+	+	.	.	+	+	.	.	1	+	+	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	+	+	+	.	.	1	+	.	.
Aristida adscensionis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	a	.	+	1	+	.	.	.	.	.	.	.	+	+	.	.	.	.	+	.	+	.	.	.	.	.	.	+	+	.	.

* Alien species

4.3 Description of plant communities

All the species and species groups that will be referred to are included in Table 4.1. The values given for anthropogenic influences, such as bush thickening and disturbance are averages for the community or sub-community being discussed. This is also the case in the description of the physiognomy of each community. Some species were only recorded once or a few times with a low cover abundance or they were not confined to a specific species group. These species were not included in Table 4.1, but they are given in Table 4.4 at the end of this chapter.

1. *Aristida congesta* subsp. *barbicollis* – *Acacia tortilis* Community

The *Aristida congesta* subsp*. barbicollis – Acacia tortilis* Community (Figure 4.2) was found on sandy loam soil. The soil was deeper than the soil of Communities 2 and 3, with moderate compaction. This community was located on foot- and midslopes, north and south of the Dwarsberg and it covered the greatest area of all the communities in the Ae land type. The most common soil forms found in this community were Bainsvlei, Hutton, Shortlands and Glenrosa, but Valsrivier, Brandvlei and Mispah were also found. Particle distribution for particles smaller than 2 mm was: sand = 61.8 %, silt = 20.2 % and clay = 18 %. Particles larger than 2 mm made up 4.8 % of the soil. Soil depth varied from 15 to more than 120 cm, with an average of 81 cm. Clay percentage and soil depth were variable for this community. Disturbance, such as compaction and overgrazing played an important role in distinguishing this community from Communities 2 and 3.

Figure 4.2 *Aristida congesta* subsp. *barbicollis – Acacia tortilis* Community (Community 1) of the Ae land type. GPS reading: lat 25°02'05.6"S, long 26°48'02.7"E. Note the well developed grass stratum and the dominant tree species *Acacia tortilis*.

The area was used for cattle grazing, with moderate overgrazing in some of the sites and low to moderate levels of sheet erosion. Average bush thickening was 32 %, varying from 1 to 80 %. Surface crusting varied from rare to somewhat common.

The species in species group A were the diagnostic species for this community. They included the grasses *Aristida congesta* subsp*. barbicollis* and *Brachiaria nigropedata*, and the geophytes *Oxalis obliquifolia* and *Raphionacme hirsuta*, which are all perennial species. Dominant species were the grasses *Digitaria eriantha, Cymbopogon pospischilii* (species group O) and *Aristida congesta* subsp*. barbicollis* (species group A) and the tree *Acacia tortilis* (species group O)*.* An average of 52 species was recorded per relevé for the *Aristida congesta* subsp*. barbicollis – Acacia tortilis* Community and 3.8 % of the recorded species were alien species. The protected trees *Combretum imberbe* and *Sclerocarya birrea* (Department of Water Affairs and Forestry, 2007) were found a few times and *Elaeodendron transvaalensis* was found once in this community.

The grass stratum formed the dominant stratum and had a cover of 48 % and was 0.5 m tall. The tree and forb strata both had a cover of 14 %, with a height of 3.5 m for the tree stratum and 0.3 m for the forb stratum. The shrub stratum had a cover of 10 % and was 1.1 m in height.

The *Aristida congesta* subsp*. barbicollis – Acacia tortilis* Community could be divided into three sub-communities.

1.1 *Hermannia tomentosa – Dichrostachys cinerea* Sub-community.

This sub-community was found on sandy loam soil that was shallower than those of the other two sub-communities. It was found on foot- and midslopes, with an average soil depth of 70 cm. Particle distribution for particles smaller than 2 mm was: sand = 64.7 %, silt = 20.5 % and clay = 14.8 %. Particles larger than 2 mm made up 1.9 % of the soil. Low to moderate levels of sheet erosion and compaction were encountered and bush thickening was 26 %.

The diagnostic species for the *Hermannia tomentosa – Dichrostachys cinerea* Sub-community were the perennial herbs *Hermannia tomentosa* and *Euphorbia inaequilatera* (species group B). Dominant species were the perennial grasses *Eragrostis rigidior* (species group O)*, Aristida congesta* (species group A) and the trees *Dichrostachys cinerea* and *Acacia tortilis* (species group O)*.* This sub-community had a species richness of 59 species per relevé and 4.8 % of the species were aliens, which was the highest of the three sub-communities.

The grass, tree, forb and shrub strata had covers of 54 %, 19 %, 21 % and 12 % respectively.

1.2 *Acacia robusta – Acacia nilotica* Sub-community

The *Acacia robusta – Acacia nilotica* Sub-community was found on sandy clay loam soil on footslopes. Particle distribution for particles smaller than 2 mm was: sand = 50.7 %, silt = 26.6 % and clay = 22.7 %. Particles larger than 2 mm made up 11 % of the soil. The soil had an average depth of 75 cm. This sub-community was associated with a high concentration of potassium (319 mg/kg) in the soil. Bush thickening was 57 %, which is quite high, compared to the two other sub-communities. Moderate levels of overgrazing, sheet erosion and compaction were recorded in this sub-community.

Although species group C contained the diagnostic species for this sub-community, it was better characterised by the absence of species groups B and D. The trees *Acacia nilotica* (species group O) and *Acacia caffra* (species group F) had a much higher occurrence and percentage cover in this sub-community than in the other two sub-communities. Other dominant species were the tree *Acacia tortilis* and the perennial grasses *Digitaria eriantha* and *Cymbopogon pospischilii* (species group O). The *Acacia robusta – Acacia nilotica* Sub-community had an average species richness of 52 species per relevé and of all the species that were recorded 4.1 % were alien species. The protected tree *Boscia albitrunca* (Department of Water Affairs and Forestry, 2007) was found in this sub-community.

In this sub- community the grass stratum also formed the dominant stratum with a cover of 38 %. The cover for the tree stratum was 18 %. It was 12 % for the shrub stratum and 9 % for the forb stratum.

1.3 *Sida dregei – Acacia tortilis* Sub-community

This sub-community was found on sandy loam soil which was the deepest of the three sub-communities (96 cm). Particle distribution for particles smaller than 2 mm was: sand = 69.9 %, silt = 13.6 % and clay = 16.5 %. Particles larger than 2 mm made up 1.4 % of the soil. The *Sida dregei – Acacia tortilis* Sub-community was mostly found on footslopes. Average bush thickening was 13 %, which was the lowest of the three sub-communities. Low levels of overgrazing, sheet erosion and compaction were noted in this sub-community.

Diagnostic species for this community were the annual herb *Sida dregei* and the perennial herbs *Ipomoea obscura* and *Phyllanthus parvulus* (species group D), although the first two were also present in Sub-community 1.2. This sub-community was further characterised by the absence of the species in species groups B and C. The perennial grass *Themeda triandra* (species group O) had a considerably higher occurrence and percentage cover in this sub-community than in the other sub-communities. Other dominant species were the perennial grasses *Digitaria eriantha, Cymbopogon pospischilii* and *Heteropogon contortus* and the tree

Acacia tortilis (species group O). The *Sida dregei – Acacia tortilis* Sub-community had a species richness of 45 species per relevé, which was considerably lower than those of the *Hermannia tomentosa – Dichrostachys cinerea* Sub-community. The tree *Acacia erioloba* was also once encountered in this sub-community. *Acacia erioloba* is a red data species, it falls into the 'Declining' category and is on the protected trees list (South African National Biodiversity Institute, 2009; Department of Water Affairs and Forestry, 2007). Another two red data species *Boophone disticha* and *Hypoxis hemerocallidea* were found in this community. Both species fall into the 'Declining' category according to the South African National Biodiversity Institute (2009).

Only 1.3 % of the species were aliens, which was a considerably lower percentage than those of the other sub-communities. This could be correlated with the lower levels of disturbance.

The grass stratum formed the dominant stratum with a cover of 52 %. The covers for the forb, shrub and tree stata were 12 %, 9 % and 8 % respectively.

2. *Combretum imberbe – Heteropogon contortus* Community

The *Combretum imberbe – Heteropogon contortus* Community (Figure 4.3) was found on sandy loam soil, which was in general shallower (with an average soil dept of 58 cm) than those of Communities 1 and 3. It was found on footslopes, on the following soil forms: Hutton, Shortlands, Brandvlei, Mispah and Bainsvlei. Particle distribution for particles smaller than 2 mm was: sand = 78.9 %, silt = 9.2 % and clay = 12 %. Particles larger than 2 mm made up 0.7 % of the soil.

This community was distinguished from Communities 1 and 3, mainly by lower levels of disturbance. No compaction, little sheet erosion and low levels of overgrazing were observed.

It was found in the northern part of the study area on the farms Jakhalskraal and Schoongezight, north-east of Gansvley. It was the only community found in the Ae 237 land type. The land belongs to the PPC cement mining company. Before PPC bought it, the land was used for cattle grazing, but for the past 15 years it has only been used for light game grazing. Some parts were however still overgrazed and bush thickening by *Dichrostachys cinerea* was a problem in this community. PPC has a bush thinning program, in which *Dichrostachys cinerea* and *Acacia nilotica* trees are being cut down and sold as firewood. A large part of the *Combretum imberbe – Heteropogon contortus* Community was however still very dense. Along some of the roads *Dichrostachys cinerea* formed an impenetrable barrier.

Figure 4.3 The *Combretum imberbe – Heteropogon contortus* Community (Community 2) of the Ae land type. GPS reading: lat 24°49’26.9”S, long 26°48’52.9”E. This community was quite dense, as a result of bush thickening. *Acacia* species were not dominant here, but rather *Combretum* species and *Dichrostachys cinerea*.

The diagnostic species for this community fell into species group E and included the trees *Combretum imberbe*, *Sclerocarya birrea*, *Combretum hereroense, Dombeya rotundifolia* and *Pappea capensis*, the dwarf shrub *Clerodendrum suffruticosum* var. *suffruticosum*, the alien annual herb *Tagetes minuta* and the perennial grass *Cymbopogon nardus*. The dominant species of this community were the perennial grass *Heteropogon contortus,* the tree *Dichrostachys cinerea* (species group O), the dwarf shrub *Clerodendrum suffruticosum* v. *suffruticosum* (species group E), the annual grass *Enneapogon cenchroides* and the perennial climber *Rhynchosia minim*a (species group O). An average of 58 species was found per relevé. Only 2.8 % of the species found in this community were aliens, which is the lowest of all the communities. *Combretum imberbe* and *Sclerocarya birrea* are protected trees according to the Department of Water Affairs and Forestry (2007). Conservation of this community is therefore important.

The grass stratum was well developed with a cover of 49 % and it was 0.5 m tall. The cover of the tree stratum was 30 % with a height of 4.6 m, which is considerably higher than that off all the other communities, except the *Acacia erioloba – Panicum maximum* Community. The shrub stratum had a cover of 21 % and was 1.2 m tall. The forb stratum had a cover 17 % of and a height of 0.3 m.

A somewhat similar vegetation unit was identified by Zacharias (1994), namely the Mixed *Acacia* and *Combretum* veld. *Acacia tortilis* and *Acacia nilotica* were also present in the

Combretum imberbe – Heteropogon contortus community, even though they were not dominant. The survey carried out by Zacharias (1994) was not a phytosociological study, but nearly all the species found in the Mixed *Acacia* and *Combretum* veld (Zacharias, 1994), were also encountered in the *Combretum imberbe – Heteropogon contortus* community.

3. *Euclea undulata – Acacia tortilis* Community

The *Euclea undulata – Acacia tortilis* Community (Figure 4.4) was found north of the Dwarsberg on calcareous, sandy clay loam soil, on foot- and midslopes. Percentage rocks on the soil surface were high (Figure 4.11). It had an average calcium concentration of 3 500 mg/kg. The CEC (Cation Exchange Capacity), base saturation and pH were also very high for this community, because of the high calcium concentration in the soil. Particle distribution for particles smaller than 2 mm was: sand = 52.7 %, silt = 21.4 % and clay = 25.9 %. Particles larger than 2 mm made up 0.3 % of the soil. Average soil depth was 75 cm. The most common soil form in this community was Shortlands, but the Bainsvlei, Kimberley, Swartland, Glenrosa and Hutton soil forms were also encountered. Looking at the aerial photographs, it seems as if this community was found in more disturbed patches in Community 1. This is however not the most important factor, as the species composition was also unique.

Figure 4.4 The *Euclea undulata – Acacia tortilis* Community (Community 3) of the Ae land type. GPS reading: lat 24°54'35.6"S, long 26°45'34.0"E. The dominant *Acacia tortilis* trees can be seen in this photograph. The shrub *Euclea undulata* was mostly found in bush clumps.

The diagnostic species for this community were the perennial grasses *Sporobolus nitens, Eragrostis lehmanniana* and *Eragrostis racemosa* and the annual herb *Pavonia senegalensis* (species group G). It was however better characterised by the absence of the species from species groups F, H and K. The tree *Acacia robusta* and the shrub *Euclea undulata* (species group M) had a considerably higher percentage cover and occurrence in the *Euclea undulata* – *Acacia tortilis* Community than in the other four communities. Dominant species in this group were the trees *Acacia tortilis* and *Dichrostachys cinerea* and the shrub *Grewia flava* (species group O). The average species richness for this community was 50 species per relevé and 3.6 % of all the species recorded in this community were aliens. The protected trees *Combretum imberbe, Sclerocarya birrea* and *Boscia albitrunca* (Department of Water Affairs and Forestry, 2007) were found in this community.

The grass stratum formed the dominant stratum with a cover of 44 % and a height of 0.5 m. The tree stratum had a cover of 36 % and a height of 3.7 m. The shrub and forb strata had covers of 23 % and 18 % and heights of 1.2 m and 0.3 m respectively.

Some variation was encountered in this community, although sub-communities could not be identified, but the variation will be discussed. Calcium concentration varied from 2 373 mg/kg at site 72 to 4 445 mg/kg at site 9. Soil depth varied from 45 cm (site 3) to 110 cm (site 75). Disturbance also varied, being the most serious on the northern footslope of the Dwarsberg, where serious soil erosion was encountered and bush thickening was the highest (Figure 4.5). Areas with the most severe disturbance were indicated on the map and in the ordination as 3c, while the least disturbed areas were indicated as 3a, 3b was more disturbed that 3a, but less that 3c.

Figure 4.5 Overgrazing and erosion at site 75 in the *Euclea undulata* – *Acacia tortilis* Community (Community 3c) of the Ae land type. GPS reading: lat 24°57’06.4”S, long 26°43’50.6”E. Bare soil and erosion shows that this area has been severely overgrazed.

4. *Acacia erioloba – Panicum maximum* Community.

The *Acacia erioloba – Panicum maximum* Community (Figure 4.6, Figure 4.7) was found on deep (more than 120 cm deep), sandy soil in the southern part of the study area, south of the Dwarsberg and south of the mountain at Ramosibitswana, on footslopes. Soil seemed to be leached, with a relatively low electrical conductivity and base status. This community was mostly found on Hutton soil, but also occasionally on Clovelly and Shortlands soil. Particle distribution for particles smaller than 2 mm was: sand = 80.2 %, silt = 6.6 % and clay = 13.2 %. Particles larger than 2 mm made up 0.2 % of the soil.

The diagnostic species were the tree *Acacia erioloba*, the annual herbs *Commelina benghalensis* and *Portulaca quadrifida,* the grass *Cynodon dactylon* and the dwarf shrub *Lycium cinereum* (species group H). Dominant species for the *Acacia erioloba – Panicum maximum* Community were the perennial grass *Panicum maximum* (species group J) and the trees *Acacia erioloba* (species group H) and *Acacia tortilis* (species group O) (Figure 4.6). The grasses *Urochloa mossambicensis* and *Eragrostis rigidior* (species group O) also had a high percentage cover. Both sub-communities had a species diversity of 46 species per relevé. Of all the species recorded in this community 5.1 % were aliens.

Figure 4.6 The *Acacia erioloba – Panicum maximum* Community (Community 4) of the Ae land type. GPS reading: lat 24°58’58.6”S, long 26°40’59.6”E. Large *Acacia erioloba* trees and a dense stratum of the grass *Panicum maximum* were striking features of this community by which it could easily be distinguished from the other communities in the Ae land type.

The tree *Acacia erioloba* is a red data species, it falls into the ‘Declining’ category and it is also on the protected trees list (South African National Biodiversity Institute, 2009; Department of

Water Affairs and Forestry, 2007). It is therefore important to protect this community. Sand is mined on small scale south of the Dwarsberg (Figure 4.7). Another protected tree species namely *Elaeodendron transvaalensis* was also founding this community. The mining of sand pose a threat to this community, as it completely destroys vegetation and is not being controlled at present. Sand mining has to be limited or stopped completely.

Figure 4.7 Sand mining in the *Acacia erioloba – Panicum maximum* Community of the Ae land type. GPS reading: lat 24°59'37.2"S, long 26°41'53.6"E. The sand found in this area is ideal for building materials and it is mined for this purpose. The mining of sand should be controlled, as it poses a threat to the continued existence of this community.

The grass stratum formed the dominant stratum, with a cover of 41 % and a height of 0.5 m. The tree stratum had a cover of 21 % and a height of 4.9 m, which is the highest of all the Ae communities. The *Acacia erioloba* trees grow especially high in deep sandy soil (Mucina & Rutherford, 2006). The height of the trees in this community gave an indication of the depth of the soil. The forb stratum had a cover of 20 % and a height of 0.2 m and the shrub stratum had a cover of 14 % and a height of 0.2 m.

There were some differences between the sites found south of the Dwarsberg and those which were found south of the mountain at Ramosibitswana. More bush thickening was noted at the site at Ramosibitswana. Species composition differed slightly, but not enough to form two sub-communities.

This community showed some similarities with the *Acacia erioloba – Acacia fleckii* Woodland on sands, described by Van der Meulen (1979). A somewhat similar community was also described by Brown (1997), namely the *Portulaca quadrifida – Acacia tortilis* disturbed woodland that was found on coarse grained soil in the Borakalalo Nature Reserve.

The *Cymbopogon validus* (*Cymbopogon nardus*) – *Acacia nilotica* Short Open Tree veld (Kort Oop Boomveld) Community described by Pauw (1988) in the Atherstone Nature Reserve was similar to communities 1 – 4 of the Ae land type, with many of the same diagnostic and dominant species. The *Acacia tortilis* – *Acacia erubescens* Community and the *Acacia erubescens* – *Aristida barbicollis* Community described by Morris (1972) was somewhat similar to Communities 1 to 4 of the Ae land type.

5. *Brachiaria eruciformis* – *Acacia tortilis* Community

The *Brachiaria eruciformis* – *Acacia tortilis* Community (Figure 4.8) was found on deep, calcareous clay soil on foot- and midslopes. These soil are derived from mafic igneous rock material, rich in calcium and magnesium. Calcium and magnesium leaches out from the surrounding upland soil and accumulate in these lower laying soil (Stalmans & De Wet, 2003). Community 1 was found on these upland soil while Community 5 is found on the lower laying areas with calcareous clay soil. For this reason Community 5 formed patches within Community 1. These two communities were mapped as one unit, as not all of these clay patches were sampled, which made their exact location uncertain.

Figure 4.8 *Brachiaria eruciformis* – *Acacia tortilis* Community (Community 5) of the Ae land type. GPS reading: lat 24°54'38.4"S, long 26°43'20.0"E. Note the dominant grass stratum and the prominent *Acacia tortilis* trees.

Community 5 was found on vertic black clays (Rensburg and Arcadia), but also on melanic (Willowbrook) and ortic (Valsrivier and Bainsvlei) soil. The soil of this community had an average calcium content of 4 312 mg/kg. Particle distribution for particles smaller than 2 mm was: sand = 40.2 %, silt = 21.5 % and clay = 38.2 %. Particles larger than 2 mm made up 2 %

of the soil. The average soil depth was 109 cm. The land was used for cattle grazing. Low to moderate levels of overgrazing were recorded, while bush thickening varied from 0 – 70 %, with an average of 24 %.

The diagnostic species of the *Brachiaria eruciformis* – *Acacia tortilis* Community were those of species group K, which included the dominant annual grass *Brachiaria eruciformis*, the perennial grasses *Ischaemum afrum* and *Setaria incrassata,* the annual herb *Ipomoea gracilisepala* and the perennial herb *Orthosiphon amabilis. Acacia tortilis and Acacia karroo* (species group O) were the dominant trees. This community was further characterised by the absence of plants from species group J, which were present in all the other communities. The average species richness was 39 species per relevé. Of all the species recorded in this community 5.8 % were aliens, which was the highest of all the communities of the Ae land type.

The grass stratum was well developed with a cover of 46 % and 0.5 m tall. The cover of the tree, shrub and forb strata were all close to 15 %. The tree stratum was 3.4 m tall, which was average for communities with *A. tortilis* and *A. karroo* as dominant species. The shrub and forb strata were 1.1 m and 0.3 m tall respectively.

A similar association has been described by Van der Meulen (1979), namely the *Acacia tortilis* – *Aristida bipartita* Woodland Association which was found on vertic black clays of the Arcadia soil form.

There were two sub-communities, which could mainly be distinguished by differences in soil characteristics. Community 5.2 were found in lower laying areas and had a higher percentage silt and clay and wetness in the soil. These characteristics were more common in this community than Community 5.1.

5.1 *Diospyros lycioides* – *Acacia tortilis* Sub-community

The *Diospyros lycioides* – *Acacia tortilis* Sub-community was located on clay soil on foot- and midslopes. Average elevation is 1100 m above sea level, which is somewhat higher than the elevation of Sub-community 5.2. The clay and silt percentage are slightly lower and it has a higher calcium concentration than the soil from Sub-community 5.2. Soil forms represented are Valsrivier, Bainsvlei, Arcadia and Rensburg. Particle distribution for particles smaller than 2 mm was: sand = 43.8 %, silt = 19.3 % and clay = 37 %. Particles larger than 2 mm made up 3 % of the soil. The average soil depth recorded was 112 cm. Average bush thickening is 23 %, with moderate overgrazing and erosion at some of the sites. One of the relevés at site 15 fell into this community and the other relevé fell into community 3, because the soil was different. This was the only site in the Ae land type where relevé pairs did not fall into the same community.

The diagnostic species for the *Diospyros lycioides – Acacia tortilis* Sub-community were found in species group L and included the shrub *Diospyros lycioides,* the annual grass, *Panicum schinzii* and the perennial grasses *Eragrostis inamoena* and *Sorghum versicolor*. This community was distinguished from Community 5.2 by the absence of the species from group N. Dominant species were the annual grass *Brachiaria eruciformis* (species group K), the trees *Acacia tortilis, Acacia karroo* (species group O) and the shrub *Euclea undulata* (species group M). The alien, annual herb *Schkuhria pinnata* (species group O) was also dominant, indicating disturbance. This sub-community had an average species richness of 46 species per relevé. Of all the species recorded in this community 4.9 % were aliens. The protected tree *Combretum imberbe* (Department of Water Affairs and Forestry, 2007) was found once in this sub-community.

The grass stratum was the dominant stratum, with a cover of 50 %. The tree, shrub and forb strata had covers of 25 %, 20 % and 21 % respectively. Heights of the different strata did not vary considerably between the two sub-communities.

5.2 *Aspilia mossambicensis – Acacia tortilis* Sub-community

The *Aspilia mossambicensis – Acacia tortilis* Sub-community was found on clay soil, of the Rensburg and Willowbrook soil forms, on footslopes. Average elevation was 1 071 m above sea level, which was lower than the elevation of community 5.1. Wetness in the soil was more common in this sub-community. Particle distribution for particles smaller than 2 mm was: sand = 36.7 %, silt = 23.8 % and clay = 39.5 %. Particles larger than 2 mm made up 1.1 % of the soil. The soil has an average depth of 108 cm. The soil was vertic or melanic and cracks could typically be seen on the surface. Bush thickening varied from 0 to 70 %, with an average of 23 %, while very little erosion was noted and the level of overgrazing varied from none to moderate.

The diagnostic species were the perennial herbs *Aspilia mossambicensis* and *Convolvulus sagittatus* and the perennial grasses *Dichanthium annulatum* and *Urelytrum agropyroides* (species group N). It could further be distinguished from Sub-community 5.1 by the absence of the species in species group L. Dominant species in this group were the annual grass *Brachiaria eruciformis* and the perennial grasses *Setaria incrassata* and *Ischaemum afrum* (species group K). All three of these species were typically associated with heavy clay soil (Van Oudtshoorn, 2004). Dominant trees were the trees *Acacia tortilis* and *Acacia karroo* (species group O). The species richness was 36 species per relevé, which were 10 lower than the species richness of Sub-community 5.1. A total of 8.4 % of the species found in this community were aliens.

Once again, the grass stratum formed the dominant stratum, with an average cover of 44 %, the shrub and forb stratum both had a cover of 13 % and the tree stratum had the lowest cover of 9.7 %.

4.4 Ordinations

Correspondence Analysis (CA) and Principal Component Analysis (PCA) ordinations were carried out to determine the correlations between the species data and the environmental data of the sample plots in the different plant communities, by investigating the correlation coefficients between the environmental factors and the two ordination axes. Quantitative environmental variables, such as soil depth and clay percentage were indicated by arrows, which reflected certain gradients. In Figure 4.10 both quantitative and qualitative environmental variables are shown. Qualitative environmental variables were indicated with a blue star and it is important to note that they do not indicate any gradients. It is important to keep in mind that CA ordinations are indirect ordinations, implying that the distribution of the relevés in the ordination is only influenced by species composition. Environmental variables were overlain and therefore show a correlation with the relevés and communities, but it does not directly influence the distribution of the relevés. For more information on the ordinations and why they were chosen for analysis, see Chapter 3.

A CA biplot was carried out including all the communities of the Ae land type (Figure 4.9). From table 4.2 it is clear that there was a strong correlation between ordination axis 1 and clay percentage (correlation coefficient = 0.48). Even though there was a wide range in clay percentage for the relevés in Community 5 (the *Brachiaria eruciformis* – *Acacia tortilis* Community), there was a clear separation between Community 5 and the other communities, because of the higher clay percentage in general in Community 5. Community 5 was mostly found on vertic clay soil forms. The second axis was correlated with soil depth and had a correlation coefficient of 0.34 (Table 4.2). This indicated that Communities 3 and 4 were found on deeper soil than Communities 1 and 2. Community 4 is therefore positively correlated with deeper, sandy soil.

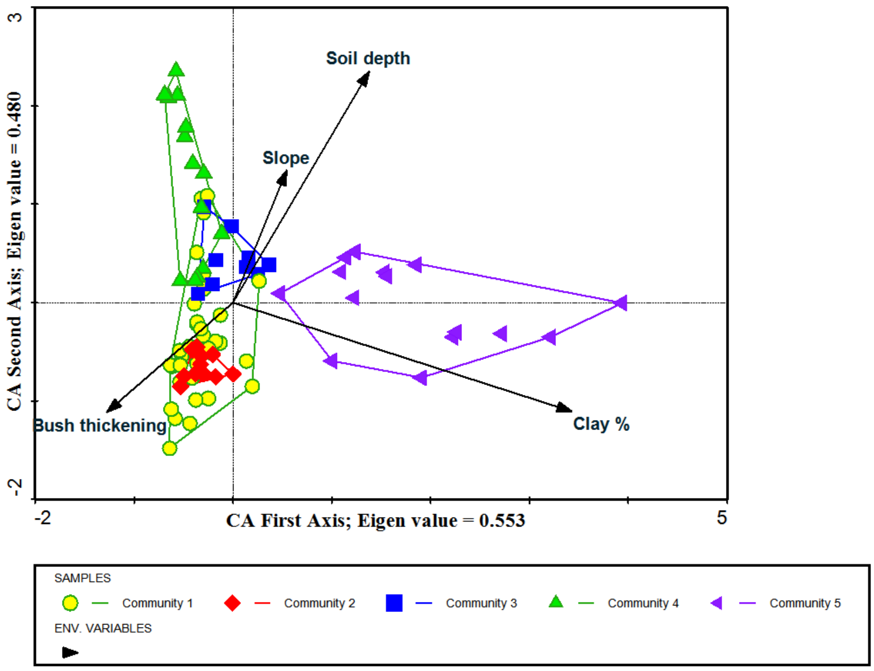

Figure 4.9 CA ordination biplot showing environmental variables and samples/relevés of the Ae land type, Communities 1 to 5: the *Aristida congesta* subsp. *barbicollis* – *Acacia tortilis* Community (1), the *Combretum imberbe* – *Heteropogon contortus* Community (2), the *Euclea undulata* – *Acacia tortilis* Community (3), the *Acacia erioloba* – *Panicum maximum* Community (4) and the *Brachiaria eruciformis* – *Acacia tortilis* Community (5).

Table 4.2 Correlation coefficients of environmental factors of Figure 4.9.

Environmental Factor	Ordination Axis 1	Ordination Axis 2
Clay %	0.4811	-0.1609
Soil depth	0.1934	0.342
Bush thickening	-0.1791	-0.1621
Slope	0.0765	0.1954

To elucidate the differences between Communities 1 to 3, another CA ordination was carried out, excluding Communities 4 and 5, (Figure 4.10). In this CA ordination there was a strong negative correlation between ordination axis 1 and bush thickening (correlation coefficient = -0.59, Table 4.3). In Communities 1 -3 bush thickening was the lowest in Community 1 and higher in Communities 2 and 3. Ordination axis 2 was correlated with 'compaction', with a correlation coefficient of 0.69 (Table 4.3). Compaction and overgrazing were however qualitative environmental variables. There is therefore not a gradient, but one can still see that compaction was the least in Community 2. Moderate to weak compaction were more often associated with Community 1. It seems strange that Community 2 was correlated with bush thickening and at the same time there was little compaction and overgrazing. The explanation for this is that there was probably overgrazing in the past, before PPC bought the land on which this community was found, which led to bush thickening. Since PPC bought the land fifteen years ago, there has been no cattle grazing and only some game grazing, which might have given the rangeland time to recover from overgrazing and compaction. Mechanical control methods have to be implemented (and is already being implemented) to rectify the bush thickening problem.

A high percentage rocks on the soil surface was associated with Community 3 (Figure 4.10). Soil depth was associated with Community 1, indicating that Community 1 was found in the deepest soil of the three communities.

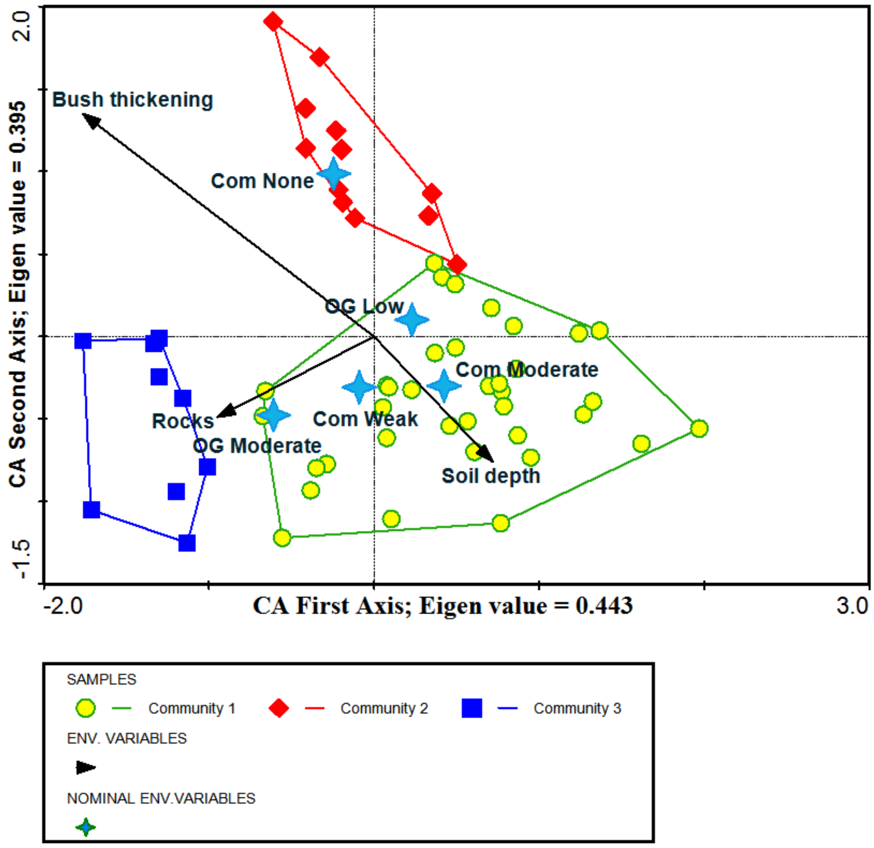

Figure 4.10 CA ordination biplot showing environmental variables and samples/relevés of Communities 1 to 3 of the Ae land type: the *Aristida congesta* subsp. *barbicollis – Acacia tortilis* Community (1), the *Combretum imberbe – Heteropogon contortus* Community (2) and the *Euclea undulata – Acacia tortilis* Community (3). 'OG' indicated overgrazing and 'Com' is compaction.

Table 4.3 Correlation coefficients of environmental factors of Figure 4.10.

Environmental Factor	Ordination Axis 1	Ordination Axis 2
Soil depth	0.2413	-0.2624
Bush thickening	-0.5936	0.4680
Rocks	-0.3192	-0.1688
Overgrazing Low	0.2914	0.1321
Overgrazing Moderate	-0.4022	-0.3243
Compaction None	-0.1671	0.6915
Compaction Weak	-0.1144	-0.4022
Compaction Moderate	0.2974	-0.2149

A PCA ordination was carried out using the data from the soil analyses (Figure 4.11). From this ordination it is evident that Community 5 was associated with clayey soil and Communities 2 and 4 with sandy soil. Community 1 was correlated with a higher concentration of potassium in the soil. Communities 3 and 5 were found on calcareous soil, which caused the Cation Exchange Capacity (CEC) and the base saturation to be higher. As mentioned earlier, some variation was encountered in Community 3. The most disturbed parts were referred to as 3c and the least disturbed as 3a. In Figure 4.11 it can be seen that the soil chemistry is also different. Community 3c had higher percentage silt in the soil and Community 3a had a higher pH and base saturation.

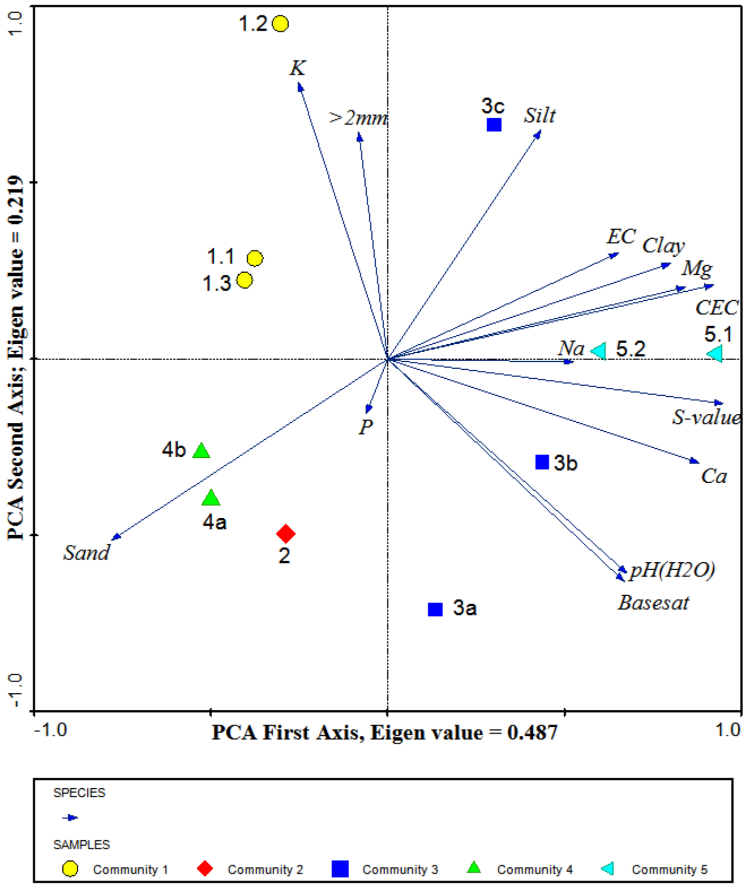

Figure 4.11 PCA ordination biplot of the soil analysis data at the different communities and sub-communities of the Ae land type. The following communities were indicated on this graph: the *Aristida congesta* subsp. *barbicollis* – *Acacia tortilis* Community (1): The *Hermannia tomentosa* – *Dichrostachys cinerea* Sub-community (1.1), the *Acacia robusta* – *Acacia nilotica* Sub-community (1.2) and the *Sida dregei* – *Acacia tortilis* Sub-community (1.3), the *Combretum imberbe* – *Heteropogon contortus* Community (2), the *Euclea undulata* – *Acacia tortilis* Community (3) of which 3a was the least disturbed and 3c was the most disturbed, the *Acacia erioloba* – *Panicum maximum* Community (4) of which 4a was found south of the Dwarsberg and 4b was found south of the mountain at Ramosibitswana, the *Brachiaria eruciformis* – *Acacia tortilis* Community (5): the *Diospyros lycioides* – *Acacia tortilis* Sub-community (5.1) and the *Aspilia mossambicensis* – *Acacia tortilis* Sub-community (5.2).

4.5 Map units and soil

Communities 2 and 4 formed clear separate units on the vegetation map (Figure 4.1). Community 2 was located in the northern part of the study area and Community 4 was located south of the Dwarsberg and the mountain at Ramosibitswana. Community 1 made up the largest area of the communities of the Ae land type and Communities 3 and 5 were found as patches within Community 1. Community 3 was found in areas with denser vegetation, due to overgrazing and bush thickening. As mentioned earlier in this chapter, Community 5 was found on the lower laying areas with calcareous clay soil, which formed patches within the higher laying Community 1. Soil characteristics differed considerably and therefore two clearly unique communities were formed. These two communities were mapped as one unit, as not all of these clay patches were sampled, which made their exact location uncertain.

In the study area the majority of the soil had ortic A-horizons. Only eight of the 86 relevés completed in the Ae land type were found on vertic black ultramafic clays (Arcadia and Rensburg soil forms) and four on melanic clays (Willowbrook soil form). Fifty four (54) of the relevés were found on soil with a ortic A-horizon and a red B-horizon of which 39 were apedal (Hutton, Bainsvlei and Kimberley soil forms) and 15 structured (Shortlands soil form). This verifies the description of the soil of the Dwaalboom Thornveld as described by Mucina & Rutherford (2006).

In some cases there was a large difference between the clay percentage determined by the ‘sausage method’ and that of the lab analysis occurred. Clay percentage determined with the ‘sausage method’ was in general higher than clay percentage determined by the lab analyses, because the silt in the soil made the clay percentage seem higher in the ‘sausage method’. Silt was measured separately in the laboratory tests which explained the differences found.

4.6 Species composition

Of all the species recorded in the Ae land type, 96 % was indigenous and 75 % was perennial. Two thirds of the alien species were annual and therefore did not pose a serious threat to the indigenous plants. The most common growth form was herbs, then shrubs and graminoids (Figure 4.12). The average species richness was 49 species per relevé.

4.7 Conclusion

The Ae land type in the Central Corridor Area (CCA) falls into the Dwaalboom Thornveld vegetation type described by Mucina & Rutherford (2006), which is characterized by *Acacia* species and is found on deep soil. Five communities and five sub-communities were identified and described in the Ae land type in the CCA. From the ordinations and the averages of the environmental data it could be concluded that soil depth and clay percentage played a major role in the species composition and distribution of the communities.

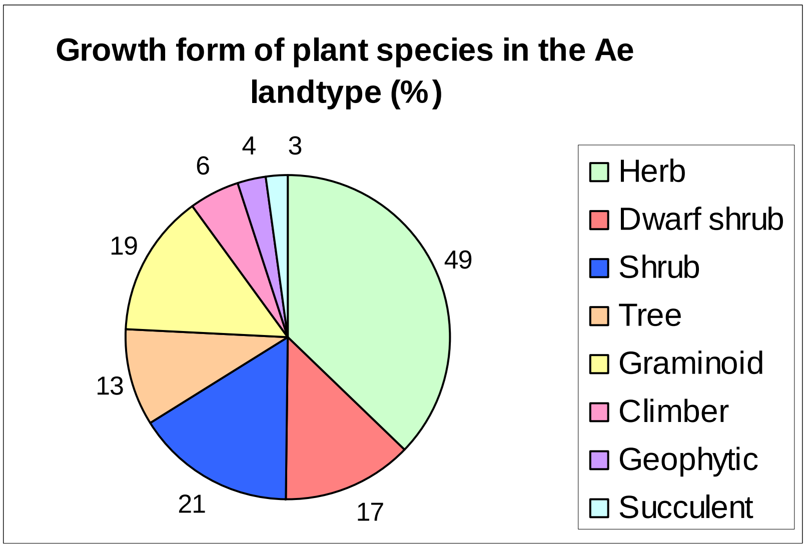

Figure 4.12 Composition of the different growth forms of the species in the Ae land type.

The *Acacia erioloba – Panicum maximum* Community (Community 4) was found on deep sandy soil and the *Brachiaria eruciformis – Acacia tortilis* Community (Community 5) on deep clayey soil with a high calcium content. Communities 1 to 3 were found on shallower soil than Communities 4 and 5. The *Euclea undulata – Acacia tortilis* Community (Community 3) was also found on calcareous soil. The *Combretum imberbe – Heteropogon contortus* Community (Community 2) was less disturbed than Communities 1 and 3. The *Aristida congesta* subsp. *barbicollis – Acacia tortilis* Community (Community 1) was found on deeper soil with less bush thickening than Communities 2 and 3. Three red data species namely *Boophone disticha, Hypoxis hemerocallidea and Acacia erioloba* and four protected tree species: *Combretum imberbe, Elaeodendron transvaalensis, Sclerocarya birrea, Boscia albitrunca* and *Acacia erioloba* were recorded in this land type. *Acacia erioloba* that was found specifically in Community 4 is both a red data species and a protected tree species (South African National Biodiversity Institute, 2009; Department of Water Affairs and Forestry, 2007). Some similar communities were described by other authors. Zacharias (1994) described a community that was somewhat similar to Community 2 in Madikwe Game Reserve. Van der Meulen (1979) described a community that was somewhat similar to Community 4 and another community that was similar to the Community 5. Brown (1997) described a community in the Borakalalo Nature Reserve, which was somewhat similar to Community 4. Pauw (1988) and Morris (1972) described communities in the Atherstone Nature Reserve and in the Thabazimbi district respectively that was somewhat similar to Communities 1 to 4 in the Ae land type of the CCA.

Table 4.4 List of species for the Ae land type which are not shown in Table 4.1, because they occurred only once or a few times with a low cover abundance or they were not confined to specific communities.

Community	Species (relevé number)(cover abundance value)
1.	*Asclepias meliodora* (56)(+), (158)(+); *Boophone disticha* (58)(+), (63)(+); *Chamaecrista biensis* (2)(+), (4)(+), (31)(+), (172)(+), (173)(+); *Chlorophytum transvaalensis* (31)(+), (59)(+); *Cyperus obtusiflorus* (3)(+), (220)(+); *Euphorbia clavarioides* (19)(+), (20)(+), (130)(+), (168)(+); *Gnidia caffra* (20)(+), (59)(+); *Hyparrhenia hirta* (62)(1), (130)(+), (220)(+); *Macrotyloma* species (160)(+), (220)(+); *Microchloa caffra* (172)(+), (220)(+); *Solanum rubetorum* (19)(+), (31)(+), (168)(+); *Solanum supinum* (3)(+), (58)(+), (59)(+), (63)(+); *Teucrium trifidum* (1)(+), (173)(+); *Trochomeria macrocarpa* (170)(+), (220)(+)
1.1	*Acacia grandicornuta* (1)(1); *Asclepias decipiens (1)(+); Blepharis subvolubilis* (4)(+); *Chlorophytum cooperi* (220)(+); *Chlorophytum* species (62)(+); *Chrysopogon serrulatus* (62)(+), (63)(1); *Harpagophytum procumbens* (3)(+); *Hermannia depressa* (1)(+); *Hermannia stellulata* (220)(+); **Lantana camara* (56)(+); *Physalis angulata* (20)(+); *Ophioglossum lancifolia* (62)(+); *Siphonoglossa linifolia* (63)(+); *Tephrosia longipes* (220)(+); *Zornia capensis* (4)(+)
1.2	*Ammocharis coranica* (136)(+); *Convolvulus* species (58)(+); *Gymnosporia polyacantha* (61)(+); *Kalanchoe rotundifolia* (54)(+); *Rubia horrida* (54)(+); *Salvia reflexa (54)(+); **Solanum sisymbrifolium* (130)(+)
1.3	*Acacia hereroensis* (59)(1), (170)(a); *Adenia digitata* (170)(+); *Ornithogalum glaucescens* (172)(+); *Convolvulus* species (58)(+); *Cucumis hirsutus* (169)(+), (171)(+); *Dipcadi marlothii* (161)(+); *Gnidia kraussiana* (172)(+); *Harpagophytum zeyheri* (172)(+), (173)(+); *Hypoxis hemerocallidea* (59)(+); *Ipomoea crassipes* (169)(+), (171)(+); *Ipomoea magnusiana* (168)(+); *Ledebouria cooperi* (172)(+), (173)(+); *Senecio* species (172)(+); *Senna italica* (172)(+); *Thesium* species (161)(+); *Trachyandra saltii* (168)(+), (169)(+); *Trichoneura grandiglumis* (172)(+); *Vernonia galpinii* (158)(+); *Vigna vexillata* (160)(+)
2.	*Barleria pretoriensis* (201)(+); *Bulbostylis humilis* (83)(+); **Flaveria bidentis* (82)(+); *Kalanchoe thyrsiflora* (83)(+); *Kedrostis africana* (204)(+); *Lannea discolor* (201)(+); *Melhania forbesii* (203)(+), (205)(+); *Melhania virescens* (82)(+), (203)(+); *Ophioglossum* species (81)(+); *Ornithogalum* species (197)(+); *Oxalis depressa* (200)(1), (201)(+); *Rhoicissus tridentata* (80)(+); *Sebaea grandis* (80)(+), (81)(+); *Senecio consanguineus* (82)(+), (83)(+);

	Tragia rupestris (205)(+); *Ximenia caffra* (197)(+)
3.	*Achyropsis leptostachya* (148)(+), (149)(+); *Aristida rhiniochloa* (18)(+); *Boscia foetida* (5)(1), (6)(+); *Commelina* species (149)(+); *Commiphora glandulosa* (5)(+); *Commiphora schimperi* (142)(+); *Dicoma tomentosa* (17)(+); *Eragrostis aspera* (6)(+); *Indigofera melanadenia* (5)(+), (6)(a), (17)(+); Jasm*inum streptopus* (5)(+); *Kalanchoe lanceolata* (148)(+), (149)(+); *Oldenlandia herbacea* (6)(+);
4	*Anthospermum rigidum* subsp. *pumilum* (150)(+); *Asystasia schimperi* (150)(+), (151)(+); *Cleome monophylla* (152)(+); *Cyperus fulgens* (154)(+); *Dactyloctenium aegyptium* (154)(+); *Ipomoea purpurea* (151)(+); *Leucas neuflizeana* (122)(+); *Momordica balsamina* (154)(+); *Plumbago zeylanica* (151)(+); *Portulaca kermesina* (151)(+); *Ruellia patula* (122)(+), (123)(+); *Terminalia sericea* (153)(+); *Tragia incisifolia* (106)(+) *Vangueria infausta* (151)(+)
5.	*Commicarpus pentandrus* (14)(+), (114)(+), (115)(+)
5.1	*Crabbea acaulis* (30)(+); *Hypoestes forskaolii* (30)(+); *Indigofera cryptantha* (30)(+); *Justicia protracta* (30)(+); *Limeum viscosum* (30)(+); *Seddera capensis* (30)(+)
5.2	*Dinebra retroflexa* (128)(+); *Indigofera* species (99)(+), (114)(+); *Lotononis calycina* (135)(+); *Panicum volutans* (98)(+), (129)(+); *Ruelliopsis setosa* (140)(+); (141)(+)
No specific community	*Acacia burkei* (122)(b), (148)(+), (153)(b); *Acacia erubescens* (2)(1), (80)(+), (142)(+) *Acacia mellifera* (1)(+), (83)(1), (134)(1), (145)(a), (155)(1), (159)(+); *Acrotome inflata* (62)(+), (118)(+); *Aerva leucura* (30)(+), (80)(+), (123)(+), (154)(+); **Alternanthera pungens* (29)(+), (150)(+); **Amaranthus hybridus* (128)(+), (151)(+); *Antizoma angustifolia* (108)(+), (127)(+), (137)(+); *Aptosimum lineare* (83)(+), (134)(+); *Argyrolobium tomentosum* (151)(+), (160)(+); Aristida stipitata (2)(+), (4)(+), (56)(+), (220)(+); *Asparagus setaceus* (18)(+), (19)(+), (60)(+), (61)(+), (80)(+), (105)(+), (118)(+), (119)(1), (122)(+), (123)(+), (131)(+), (136)(+), (137)(+), (149)(+); **Bidens pilosa* (99)(+), (203)(+), (204)(+) ; *Boscia albitrunca* (104)(+), (137)(+), (148)(1); *Brachiaria deflexa* (131)(+), (153)(+), (154)(+), (204)(+); *Brachiaria serrata* (5)(+), (20)(+), (59)(+), (63)(1), 169(+), 196(+); *Carissa bispinosa* (29)(+), (61)(+), (148)(+); *Citrullus lanatus* (17)(+), (61)(+); *Clematis brachiata* (54)(1), (55)(+), 151(+); *Coccinia sessilifolia* (168)(+), (187)(+); *Commelina livingstonii* (5)(+), (200)(+), (202)(+); *Crotalaria burkeana* (153)(+), (158)(+), (159)(+), (160)(+); *Crotalaria globifera* (3)(+),

	(108)(+), (122)(1), (123)(+), (126)(+); *Crotalaria lotoides* (123)(+), (126)(+), (131)(+), (136)(+), (150)(+), (154)(+), (185)(1), (186)(+); *Crotalaria sphaerocarpa* (14)(+), (45)(+), (104)(+), (105)(+), (114)(+), (137)(+); *Cucumis metuliferus* (3)(+), (58)(+), (61)(+); *Cyphostemma flaviflorum* (19)(+), (54)(+), (61)(+); *Dicerocaryum eriocarpum* (62)(+), (168)(+), (4)(+); *Dicoma macrocephala* (62)(+), (63)(+), (168)(+), (187)(+); *Elaeodendron transvaalensis* (2)(+), (5)(+), (6)(+), (151)(+); *Elionurus muticus* (55)(+), (59)(+), (76)(+), (81)(1), (168)(+), (196)(+), (220)(+); *Eragrostis bicolor* (19)(+), (149)(+); *Eragrostis trichophora* (18)(+), (155)(+); *Felicia mossamedensis* (3)(+), (4)(+), (60)(+), (80)(+), (4)(a), (18)(+), (158)(+), (159)(+); **Flaveria bidentis* (57)(+), (82)(+); *Geigeria burkei* (4)(a), (18)(+), (158)(+), (159)(+); *Gladiolus permeabilis* (59)(+), (144)(+), (169)(+), (200)(+); **Gomphrena celosioides* (29)(+), (56)(+), (150)(+); *Grewia bicolor* (5)(+), (6)(+), (158)(+), (201)(+); *Grewia flavescens* (5)(+), (58)(+), (83)(+), (122)(+); *Gymnosporia senegalensis* (82)(+), (83)(+), (123)(+); *Hermannia quartiniana* (108)(+), (131)(+); *Hibiscus calyphyllus* (4)(+), (153)(+); *Holubia saccata* (18)(+), (19)(+); *Hyparrhenia filipendula* (55)(+), (62)(+), (154)(+); *Indigastrum costatum* subsp. *macrum* (3)(+), (14)(1), (17)(+), (63)(+), (140)(+), (141)(+); *Indigofera filipes* (122)(+), (142)(+), (143)(+), (200)(+), (204)(+); *Indigofera rhytidocarpa* subsp. *rhytidocarpa* (17)(+), (18)(+), (29)(+), (82)(+), (104)(+), (108)(+); *Ipomoea coscinosperma* (17)(+), (29)(+), (131)(+); *Justicia betonica* (30)(+), (59)(+), (122)(+), (153)(1); *Kalanchoe thyrsiflora* (83)(+), (99)(+); *Kedrostis foetidissima* (58)(+), (61)(+); *Leucas sexdentata* (55)(+), (82)(+), (83)(+), (123)(1), (143)(+), (204)(+); *Maerua cafra* (137)(+), (148)(+); *Malvastrum coromandelianum* (6)(+), (13)(+), (82)(+), (150)(+), (151)(+); *Menodora heterophylla* var. *australis* (54)(+), (55)(+), (200)(+); *Merremia palmata* (63)(+), (81)(+), (159)(+), (203)(+); *Ornithogalum* species (136)(+), (197)(+); *Phyllanthus maderaspatensis* (186)(+), (187)(+), (196)(+), (197)(+), (203)(+), (220)(+); *Pollichia campestris* (29)(+), (152)(+), (159)(+), (160)(+), (172)(+), (173)(+), (186)(+), (187)(+), (220)(1); *Polygala hottentotta* (56)(+), (62)(+), (81)(+), (161)(+); *Raphionacme velutina* (4)(+), (17)(+), (58)(+), (168)(+), (169)(+); *Rhus lancea* (134)(+), (154)(+); *Rhynchosia densiflora* subsp. *chrysandenia* (80)(a), (81)(+), (137)(a); *Rhynchosia totta* (13)(+), (17)(+), (18)(+), (59)(+), (61)(+), (62)(+), (81)(+), (126)(+), (153)(+), (168)(+), (169)(+), (196)(+); *Seddera suffruticosa* (1)(+), (2)(+), (141)(+), (197)(+), (205)(+); *Sesamum triphyllum* (18)(+), (19)(+), (134)(+); *Setaria pumila* (67)(+), (104)(+), (118)(+), (143)(+); *Sida ovata* (1)(+), (5)(+), (6)(+); *Solanum tettense* var.

	renschii (19)(+), (29)(+), (55)(+), (56)(+), (57)(+), (61)(+), (159)(+), (200)(+), (220)(+); *Spermacoce senensis* (3)(+), (122)(+); *Sphedamnocarpus pruriens* (1)(+), (153)(+), (158)(1), (196)(+), (197)(1); *Sphenostylis angustifolia* (3)(+), (17)(+), (83)(+), (108)(1), (159)(1), (204)(1); *Sporobolus fimbriatus* (17)(+), (18)(+), (61)(+), (62)(+), (63)(+), (105)(+), (106)(1), (108)(+), (187)(+); *Striga gesnerioides* (81)(+), (169)(+); *Stylosanthes fruticosa* (20)(+), (17)(+); *Talinum arnotii* (1)(+), (5)(+), (18)(+), (135)(+), (140)(+), (150)(+), (151)(+), (203)(+); *Talinum caffrum* (152)(+), (154)(+), (155)(+), (170)(+), (204)(+), (205)(+); *Tragia meyeriana* (3)(+), (31)(+), (57)(+), (126)(+), (151)(+), (153)(+); *Tribulus terrestris* (18)(+), (29)(+), (56)(+), (152)(+); *Tricholaena monachne* (196)(+), (153)(+); *Vernonia poskeana* (1)(+), (2)(+), (106)(+), (158)(+); *Viscum capense* (4)(+), (13)(+), (29)(+), (57)(+), (62)(+), (63)(+), (80)(+), (81)(+), (104)(+), (118)(+), (119)(+), (123)(+), (142)(+), (173)(+) ***** Alien species

Chapter 5

Classification and description of the Ea land type

5.1 Introduction

The Ea land type indicates soil with a high base status, dark coloured and/or red soil, usually clayey, associated with basic parent material. More than 50 % of this land type is covered by soil forms with vertic, melanic and red structured diagnostic horizons (Land Type Survey Staff, 1988).

The Ea land type was encountered in the north-western part (Ea 155) and on the eastern edge (Ea 70) of the study area (Figure 2.2). A total of 42 relevés were completed for this land type. Most of the Ea land type in the Central Corridor Area (CCA) falls into the Dwaalboom Thornveld vegetation type (Mucina & Rutherford, 2006). A smaller part of it however falls into the Madikwe Dolomite Bushveld (Mucina & Rutherford, 2006). See the Introduction of Chapter 4 for the description of the Dwaalboom Thornveld and the Introduction of Chapter 6 for the description of the Madikwe Dolomite Bushveld.

5.2 Plant communities of the Ea land type

The Ea land type includes the following four communities and four sub-communities (Table 5.1, Figure 5.1), namely:

1. *Peltophorum africanum - Urochloa mosambicensis* Community
2. *Melhania virescens - Tarchonanthus camphoratus* Community
    - 2.1 *Chrysopogon serrulatus - Tarchonanthus camphoratus* Sub-community
    - 2.2 *Monsonia angustifolia - Grewia flava* Sub-community
3. *Ischaemum afrum - Brachiaria eruciformis* Community
    - 3.1 *Asparagus suaveolens - Acacia nilotica* Sub-community
    - 3.2 *Aspilia mossambicensis - Acacia karroo* Sub-community
4. *Sorghum versicolor - Bothriochloa insculpta* Community

Table 5.1 Phytosociological table of the Ea land type of the Central Corridor Area of the proposed Heritage Park

Site number								1	1														1	1	1	1	1	1													1	1
	2	2	9	9	4	4	4	0	0	4	4	4	4	4	3	3	3	3	4	4	5	5	0	0	0	0	0	0	8	8	8	8	9	9	5	5	4	4	4	4	0	0
	7	7	1	1	3	3	4	7	7	0	0	4	7	7	5	5	8	8	6	6	2	2	4	4	5	5	6	6	8	8	9	9	0	0	1	1	5	5	8	8	0	0
Relevé number			1	1				2	2												1	1	2	2	2	2	2	2	1	1	1	1	1	1	1	1					1	1
	5	5	8	8	8	8	8	1	1	7	7	8	9	9	6	6	7	7	9	9	0	0	0	0	0	0	1	1	7	7	7	7	7	7	0	0	8	8	9	9	9	9
	2	3	0	1	4	5	6	2	3	8	9	7	2	3	8	9	4	5	0	1	2	3	6	7	8	9	0	1	4	5	6	7	8	9	0	1	8	9	4	5	8	9
Number of species per relevé	6	5	6	5	6	5	5	5	5	5	5	5	5	5	4	4	4	4	4	4	4	4	4	4	4	3	3	4	3	3	3	4	3	2	3	2	2	3	2	3	1	2
	4	8	1	6	1	3	5	5	1	3	8	1	4	0	1	2	3	0	6	7	3	3	2	2	1	9	8	6	7	0	8	6	8	8	0	8	7	5	3	0	8	2
Community	1				2.1					2.2					3.1														3.2								4					
Species group A (Diagnostic species of Community 1)																																										
Urochloa mosambicensis	a	1	a	b	.	+	.	.	.	+	.	.	.	.	.	+	.	.	.	.	+	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	+	.	.	.	.
Peltophorum africanum	a	a	1	a	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lippia javanica	1	a	a	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Panicum maximum	+	+	3	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Diospyros lycioides	a	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	+	.	.	.	.	.	.	.	.
Sida cordifolia	+	1	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Spermacoce senensis	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Clematis brachiata	1	+	.	a	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Cynodon dactylon	+	.	+	a	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Combretum imberbe	.	.	b	a	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ocimum americanum v. americanum	.	+	b	+	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pollichia campestris	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Sarcostemma viminale	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
*Gomphrena celosioides	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Teucrium trifidum	.	.	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Indigofera filipes	+	+	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Kalanchoe paniculata	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Vitex zeyheri	+	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Phyllanthus parvulus	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Vangueria infausta	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pavetta zeyheri	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Oxalis smithiana	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Combretum molle	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Table 5.1 (continued)																																										
Relevé no.			1	1				2	2												1	1	2	2	2	2	2	2	1	1	1	1	1	1	1	1					1	1
	5	5	8	8	8	8	8	1	1	7	7	8	9	9	6	6	7	7	9	9	0	0	0	0	0	0	1	1	7	7	7	7	7	7	0	0	8	8	9	9	9	9
	2	3	0	1	4	5	6	2	3	8	9	7	2	3	8	9	4	5	0	1	2	3	6	7	8	9	0	1	4	5	6	7	8	9	0	1	8	9	4	5	8	9
Community	1				2.1					2.2					3.1														3.2								4					
Species group B (Diagnostic species of Community 2)																																										
Tarchonanthus camphoratus	.	.	.	.	+	b	a	3	a	1	+	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Melhania virescens	.	.	.	.	+	+	1	a	1	+	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Combretum hereroense	.	.	b	.	+	+	1	.	.	.	+	+	+	+	.	.	1	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Kyphocarpa angustifolia	.	+	.	.	+	1	+	+	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Indigofera zeyheri	.	.	.	.	.	.	+	+	+	+	+	+	+	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Indigofera heterotricha	.	.	.	.	+	.	+	+	+	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Nidorella resedifolia s. *resedifolia*	.	.	.	.	+	+	+	+	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Peristrophe transvaalensis	.	.	.	.	1	b	.	.	.	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rhynchosia totta	.	+	.	.	.	.	+	+	.	+	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Berchemia zeyheri	.	.	.	.	+	b	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sphenostylis angustifolia	.	.	.	.	+	.	.	.	+	.	1	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
**Chenopodium album*	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Table 5.1 (continued)																																										
Relevé no.			1	1				2	2												1	1	2	2	2	2	2	2	1	1	1	1	1	1	1	1					1	1
	5	5	8	8	8	8	8	1	1	7	7	8	9	9	6	6	7	7	9	9	0	0	0	0	0	0	1	1	7	7	7	7	7	7	0	0	8	8	9	9	9	9
	2	3	0	1	4	5	6	2	3	8	9	7	2	3	8	9	4	5	0	1	2	3	6	7	8	9	0	1	4	5	6	7	8	9	0	1	8	9	4	5	8	9
Community	1				2.1					2.2					3.1														3.2								4					
Species group C (Diagnostic species of Sub-community 2.1)																																										
Chrysopogon serrulatus	.	.	.	.	.	+	b	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Geigeria burkei	+	.	.	.	.	+	+	1	a	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Clerodendrum suffruticosum v. *suffruticosum*	.	.	.	.	a	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Aptosimum lineare	.	.	.	.	.	+	+	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pappea capensis	.	.	1	.	+	a	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dicliptera species	.	.	.	.	.	.	.	a	a	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bulbostylis humilis	.	.	.	.	.	+	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dombeya rotundifolia	.	.	a	.	+	1	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Grewia monticola	.	.	.	.	+	1	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ruellia cordata	.	.	+	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.
Anthephora pubescens	.	.	.	.	.	.	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Felicia mossamedensis	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Evolvulus alsinoides	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Seddera suffruticosa	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Gymnosporia senegalensis	.	.	.	.	+	.	.	+	+	.	.	.	.	.	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Eragrostis trichophora	.	+	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Felicia muricata	.	.	.	.	.	.	.	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ozoroa paniculosa	.	.	.	.	.	.	.	+	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Species group D (Diagnostic species of Sub-community 2.2)																																										
Rhynchosia densiflora s. *chrysandenia*	.	.	.	.	.	.	.	.	.	b	a	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Boerhavia diffusa	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ptycholobium plicatum	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Monsonia angustifolia	.	.	.	.	.	.	+	.	.	.	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Cymbopogon nardus	.	.	.	.	1	.	.	.	.	.	.	a	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Grewia flavescens	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Striga asiatica	.	.	.	+	.	.	.	.	.	.	.	+	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.
Abutilon angulatum	.	.	.	.	.	.	.	.	.	.	.	+	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Aristida congesta s. *barbicollis*	.	.	+	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Table 5.1 (continued)

Relevé no.	52	53	180	181	84	85	86	212	213	78	79	87	92	93	68	69	74	75	90	91	102	103	206	207	208	209	210	211	174	175	176	177	178	179	100	101	88	89	94	95	198	199
Community	1				2.1					2.2					3.1														3.2								4					
Species group E																																										
Heteropogon contortus	+	1	.	+	a	1	a	a	a	.	.	b	a	a	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Acacia caffra	+	+	+	1	+	.	+	.	+	.	+	a	b	b	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.
Eragrostis rigidior	1	1	+	+	1	.	+	+	+	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.
Gymnosporia heterophylla	1	.	.	+	+	1	+	.	.	a	3	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pupalia lappacea	.	.	+	+	+	.	.	.	+	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Aerva leucura	.	+	.	+	+	+	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Euphorbia inaequilatera v. inaequilatera	+	.	+	.	.	.	.	+	+	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.
Leucas sexdentata	+	+	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Flueggea virosa	.	+	+	.	.	.	.	.	.	.	+	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Aristida congesta s. congesta	+	.	.	+	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Species group F (Diagnostic species of Community 3)																																										
Ischaemum afrum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1	+	1	+	1	+	a	+	+	1	+	a	a	1	1	+	+	1	+	+	.	.	.	.	1	a
Urelytrum agropyroides	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	+	1	1	b	.	.	+	+	+	+	+	+	+	+	1	+	1	1	.	1	.	.	.	.	.	.
Orthosiphon amabilis	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	+	.	.	+	+	+	+	.	.	.	.	1	1	+	+	+	+	+	1	.	.	.	.	.	.
Panicum schinzii	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	a	1	+	.	+	.	.	1	+	.	+	+	1	+	.	+	+	+	.	.	.	.	.	.	.	.	+
Dichanthium annulatum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	+	+	1	+	+	+	.	b	1	.	.	1	+	.	.
Rhus pyroides	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	1	+	.	+	1	.	.	.	.	.	.	+	+	.	+	+	.	+	+	.	.	+	.	.	.
Corchorus asplenifolius	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	+	+	.	.	.	.	.	+	+	.	+	+	+	+	.	.	.	.	.	.	.	.
Vernonia oligocephala	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	+	.	.	.	.	+	.	.	.	.	.	.	+	+	1	1	.	1	.	.	.	.	.	.
Commelina africana	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	+	.	+	.	+	.	.	.	+	+	.	.	.	.
Ipomoea coscinosperma	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	+	.	1	+	+	.	.	.	.	.	.	.	.	.	.

Table 5.1 (continued)																																										
Relevé no.			1	1				2	2												1	1	2	2	2	2	2	2	1	1	1	1	1	1	1	1					1	1
	5	5	8	8	8	8	8	1	1	7	7	8	9	9	6	6	7	7	9	9	0	0	0	0	0	0	1	1	7	7	7	7	7	7	0	0	8	8	9	9	9	9
	2	3	0	1	4	5	6	2	3	8	9	7	2	3	8	9	4	5	0	1	2	3	6	7	8	9	0	1	4	5	6	7	8	9	0	1	8	9	4	5	8	9
Community	1				2.1					2.2					3.1														3.2								4					
Species group G (Diagnostic species of Sub-ommunity 3.1)																																										
Asparagus suaveolens	+	.	+	+	.	+	+	.	.	.	+	.	.	+	1	+	+	+	1	+	+	+	+	+	+	+	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.
Acacia robusta	.	+	.	1	+	+	.	+	.	.	.	.	.	a	3	a	a	a	+	+	.	.	1	a	b	b	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Eragrostis chloromelas	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	a	+	1	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ipomoea gracilisepala	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	1	.	.	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+	.	.	.	.
Crotalaria sphaerocarpa	+	.	.	.	.	.	.	.	.	.	.	+	.	.	+	+	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Viscum capense	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	+	.	+	.	.	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Rhus lancea	.	+	.	.	.	.	.	.	.	+	.	.	.	.	+	.	.	.	.	.	+	1	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	+	.	.
Senecio species	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Commicarpus pentandrus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
**Malvastrum coromandelianum*	.	.	.	.	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	+	.	.	.	.	.	.	.	.	.	+	.	.	.	.
Hermbstaedtia odorata	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.
Ceratotheca triloba	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dinebra retroflexa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	a	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
**Amaranthus hybridus*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	a	a	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
**Salvia reflexa*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	.	.	.	.	.	.	.	.	+	+	.	.	.	.
Senecio consanguineus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.

Table 5.1 (continued)																																										
Relevé number			1	1				2	2												1	1	2	2	2	2	2	2	1	1	1	1	1	1	1	1					1	1
	5	5	8	8	8	8	8	1	1	7	7	8	9	9	6	6	7	7	9	9	0	0	0	0	0	0	1	1	7	7	7	7	7	7	0	0	8	8	9	9	9	9
	2	3	0	1	4	5	6	2	3	8	9	7	2	3	8	9	4	5	0	1	2	3	6	7	8	9	0	1	4	5	6	7	8	9	0	1	8	9	4	5	8	9
Community	1				2.1					2.2					3.1														3.2								4					
Species group H																																										
Digitaria eriantha	.	.	+	b	+	.	+	b	a	.	a	b	b	3	1	1	3	b	+	1	1	1	b	b	1	1	3	b	.	.	+	1	+	+	.	.	.	.	.	.	.	.
Grewia flava	a	a	+	+	+	.	1	a	3	3	1	1	1	a	3	3	a	1	+	+	1	1	+	1	.	+	a	+	+	.	+	+	+	+	.	.	.	.	.	.	+	.
Ziziphus mucronata	1	+	1	a	+	1	+	1	1	a	1	.	1	1	+	+	+	+	+	+	+	1	+	.	+	1	+	.	.	+	.	.	+	.	.	.	.	.	.	.	.	+
Enneapogon cenchroides	+	b	.	.	+	b	1	1	1	a	+	1	a	.	+	+	+	+	+	+	+	+	+	.	.	+	+	1	.	+	+	.	.	.	.	.	+	1	.	1	.	.
Fingerhuthia africana	.	.	.	.	.	.	+	a	a	.	+	+	+	1	1	+	1	1	.	+	1	1	1	+	.	.	b	.	.	.	.	.	+	+	.	.	+	+	.	+	.	.
Pentarrhinum insipidum	+	+	+	.	1	1	+	+	.	+	+	1	+	+	+	+	.	.	1	+	1	.	1	+	1	.	a	+	.	.	.	.	.	.	.	.	.	+	.	+	.	.
Rhus leptodictya	+	+	1	+	+	1	.	+	+	1	.	+	+	+	.	+	+	1	1	.	+	.	+	+	+	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Indigofera charliriana v. *charliriana*	.	.	.	.	+	+	+	+	+	.	+	+	+	+	a	a	+	+	+	b	+	1	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	+	+	.	.
Setaria verticillata	.	+	+	+	a	1	.	.	.	1	.	.	.	.	1	+	.	.	.	+	1	+	1	4	b	+	b	a	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Enneapogon scoparius	.	+	+	.	a	.	+	+	1	+	+	+	.	+	.	1	1	+	.	.	.	+	a	+	.	.	a	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.
Leucas martinicensis	+	+	.	.	+	+	.	.	.	+	+	+	1	1	+	.	+	.	+	+	+	.	+	.	+	+	.	.	.	.	.	.	.	.	+	+	.	+	.	.	.	.
**Achyranthes aspera*	1	a	.	.	+	.	.	.	.	+	+	.	.	.	.	+	.	.	+	.	+	.	+	+	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Euclea undulata	.	+	1	+	.	+	.	+	+	b	.	.	.	.	.	+	1	.	.	.	+	.	+	1	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ehretia rigida	.	+	+	.	.	.	+	1	1	+	.	+	.	1	+	+	.	.	+	.	.	+	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pavonia burchellii	.	.	.	+	+	+	.	.	+	+	.	.	.	.	1	+	+	.	.	.	+	.	.	+	.	.	+	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Aristida canescens	1	b	.	.	.	.	.	.	.	+	1	.	+	+	.	.	.	.	+	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Species group I (Diagnostic species of Sub-community 3.2)																																										
Aspilia mossambicensis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	1	.	.	a	+	1	1	1	1	1	1	.	.	.	.	.	.
Asparagus laricinus	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	+	+	.	+	.	.	+	.	.	.	.	1	1	.	+	+	.	1	+	.	.	.	.	.	.
Themeda triandra	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	+	+	+	+	+	.	+	+	.	.	.	.	.	.
Aristida diffusa	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	a	a	b	b	+	1	.	.	.	.	+	+	.	.
Commelina livingstonii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	1	.	+	.	.	.	.	.	.	.	.
Gladiolus eliotii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+	.	.	.	.	.	.	.	.
Convolvulus sagittatus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	+	.	.	.	+	.	.	.	.	.	.
Nidorella anomala	.	.	+	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+	.	.	.	.	.	.	.	.
Species group J (Diagnostic species of Community 4)																																										
Sorghum versicolor	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	+	+	.	+	+	+
Cenchrus ciliaris	.	.	.	.	.	a	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	.	.	+

Table 5.1 (continued)

Relevé number			1	1				2	2												1	1	2	2	2	2	2	2	1	1	1	1	1	1	1	1					1	1
	5	5	8	8	8	8	8	1	1	7	7	8	9	9	6	6	7	7	9	9	0	0	0	0	0	0	1	1	7	7	7	7	7	7	0	0	8	8	9	9	9	9
	2	3	0	1	4	5	6	2	3	8	9	7	2	3	8	9	4	5	0	1	2	3	6	7	8	9	0	1	4	5	6	7	8	9	0	1	8	9	4	5	8	9
Community	1				2.1					2.2					3.1														3.2								4					
Species group K																																										
Brachiaria eruciformis	.	.	.	.	.	.	.	.	.	+	+	+	b	a	3	3	a	+	3	a	b	b	.	1	a	1	.	+	+	+	+	+	.	.	a	b	b	3	+	a	.	.
Setaria incrassata	.	.	.	.	.	.	.	.	.	.	+	.	1	+	+	+	+	3	1	+	+	1	3	.	.	a	.	a	+	.	a	a	3	3	1	1	3	+	1	b	b	b
Bothriochloa insculpta	.	.	.	.	1	.	.	.	.	.	+	+	+	+	.	.	1	+	+	.	3	3	.	.	.	.	a	.	1	a	a	a	1	+	a	.	1	a	4	3	1	1
Eragrostis curvula	.	.	+	.	.	.	.	.	.	.	+	.	+	+	+	1	+	+	.	.	1	1	.	.	.	.	.	.	1	1	1	1	1	1	b	b	+	+	.	.	.	.
Ziziphus zeyheriana	.	.	+	.	+	.	.	.	.	.	.	a	+	+	+	.	+	.	.	+	.	.	1	+	.	.	+	+	+	.	1	+	1	+	.	.	.	.	.	.	.	.
Crabbea hirsuta	.	.	.	.	.	.	.	.	.	.	1	+	1	+	+	+	.	+	+	.	.	+	.	+	+	+	.	+	.	.	+	+	+	.	.	.	.	.	.	.	.	.
Species group L																																										
Panicum coloratum	.	.	.	.	1	.	+	+	+	+	.	.	+	.	.	.	+	.	+	+	a	a	+	+	.	.	+	.	.	.	.	.	+	+	+	+	.	.	.	.	.	.
Hibiscus trionum	.	.	.	.	+	.	+	.	.	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	.	.	.	+	+	+	.	+	+	.	1	+	1	+	+	+	.	.
Acalypha indica	+	.	.	.	+	+	+	.	.	+	+	.	.	+	.	.	.	.	+	+	.	.	.	.	.	.	+	+	.	.	.	+	.	.	.	+	+	+	+	.	.	.

Table 5.1 (continued)

Relevé no.			1	1				2	2												1	1	2	2	2	2	2	2	1	1	1	1	1	1	1	1					1	1
	5	5	8	8	8	8	8	1	1	7	7	8	9	9	6	6	7	7	9	9	0	0	0	0	0	0	1	1	7	7	7	7	7	7	0	0	8	8	9	9	9	9
	2	3	0	1	4	5	6	2	3	8	9	7	2	3	8	9	4	5	0	1	2	3	6	7	8	9	0	1	4	5	6	7	8	9	0	1	8	9	4	5	8	9
Community	1				2.1					2.2					3.1														3.2								4					
Species group M																																										
**Zinnia peruviana*	+	+	1	+	1	+	+	+	.	+	+	+	a	1	1	+	+	1	1	+	+	+	+	+	+	+	1	1	.	1	+	+	.	.	.	.	+	+	1	+	+	+
Rhynchosia minima	.	.	.	.	a	a	.	+	+	+	+	+	1	+	+	1	+	1	.	+	+	1	+	+	a	a	+	+	+	+	.	+	.	+	+	+	.	+	+	1	1	1
Cymbopogon pospischilii	.	.	+	.	+	.	.	+	+	+	b	+	a	a	1	+	3	b	+	+	1	1	+	+	+	+	1	+	1	+	a	1	1	1	+	+	.	.	.	.	.	.
Acacia nilotica	.	b	+	1	b	1	+	+	1	.	.	+	a	.	1	a	a	1	b	3	+	+	3	b	b	3	3	4	.	.	.	.	.	.	.	.	.	a	+	+	+	1
Dichrostachys cinerea	+	1	+	+	1	a	+	.	+	.	+	+	+	+	+	+	.	.	+	.	1	1	.	.	1	+	.	.	+	.	a	1	+	+	1	1	.	.	b	b	a	a
Acacia karroo	.	1	+	1	+	+	+	+	+	+	a	+	1	1	.	.	+	+	.	+	1	+	.	.	.	+	+	.	a	1	+	+	a	1	1	1	1	.	.	.	.	.
Tephrosia purpurea	.	+	.	.	+	+	+	.	+	.	.	+	+	+	1	1	.	+	a	1	+	.	+	+	.	.	1	1	+	+	+	+	+	+	.	.	b	1	+	+	+	1
**Schkuhria pinnata*	+	.	+	+	+	+	.	.	.	.	+	+	.	+	+	+	1	a	+	1	.	+	.	+	+	+	.	+	+	+	1	+	+	+	+	+	.	.	+	+	.	.
Acacia tortilis	1	.	+	.	1	+	+	1	+	b	+	+	.	.	.	+	+	1	.	+	+	a	.	.	1	+	+	.	a	a	+	1	+	.	.	1	.	1	.	.	+	+
Solanum panduriforme	.	+	.	+	.	+	.	.	.	+	+	+	+	+	.	.	.	.	.	.	.	.	+	+	+	.	.	+	+	+	.	+	.	.	+	.	.	+	1	+	+	+
Asparagus setaceus	.	.	+	.	.	.	.	+	+	+	.	.	.	.	+	1	.	.	+	.	+	+	.	+	+	+	.	+	.	.	.	+	+	+	.	.	.	.	.	.	.	.
Aristida bipartita	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	+	.	1	+	.	.	+	1	b	b	.	+	.	.	.	.	.	.	+	+	+	+	.	.	3	3
Species group N																																										
Cucumis zeyheri	+	.	+	.	+	.	.	.	.	+	+	+	+	.	.	+	.	.	+	.	.	.	.	.	+	+	+	+	.	.	.	.	.	.	.	.	+	+	.	.	.	.
Chloris virgata	+	+	.	+	.	.	.	.	.	+	.	+	.	.	.	.	.	+	.	+	+	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.
Melinis repens	.	.	.	+	.	.	+	+	+	+	.	.	.	+	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	.	+	+
**Bidens bipinnata*	+	1	a	.	+	+	+	.	.	+	+	+	.	.	+	+	+	+	+	+	+	+	+	+	+	+	+	b	.	.	.	.	.	.	.	.	1	1	+	.	1	+
Lantana rugosa	+	+	.	.	+	.	+	+	1	+	+	1	1	1	+	1	+	+	+	+	.	.	+	+	.	.	+	+	.	+	.	.	.	.	.	.	.	+	+	+	.	+
**Tagetes minuta*	3	+	+	.	+	+	+	.	.	1	+	1	+	.	+	.	+	.	+	+	.	.	.	.	+	.	.	.	.	+	.	.	.	.	.	.	1	.	.	+	1	+
Sida spinosa	+	+	+	1	+	+	.	.	.	+	+	.	+	+	.	.	.	+	.	+	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+

* Alien species

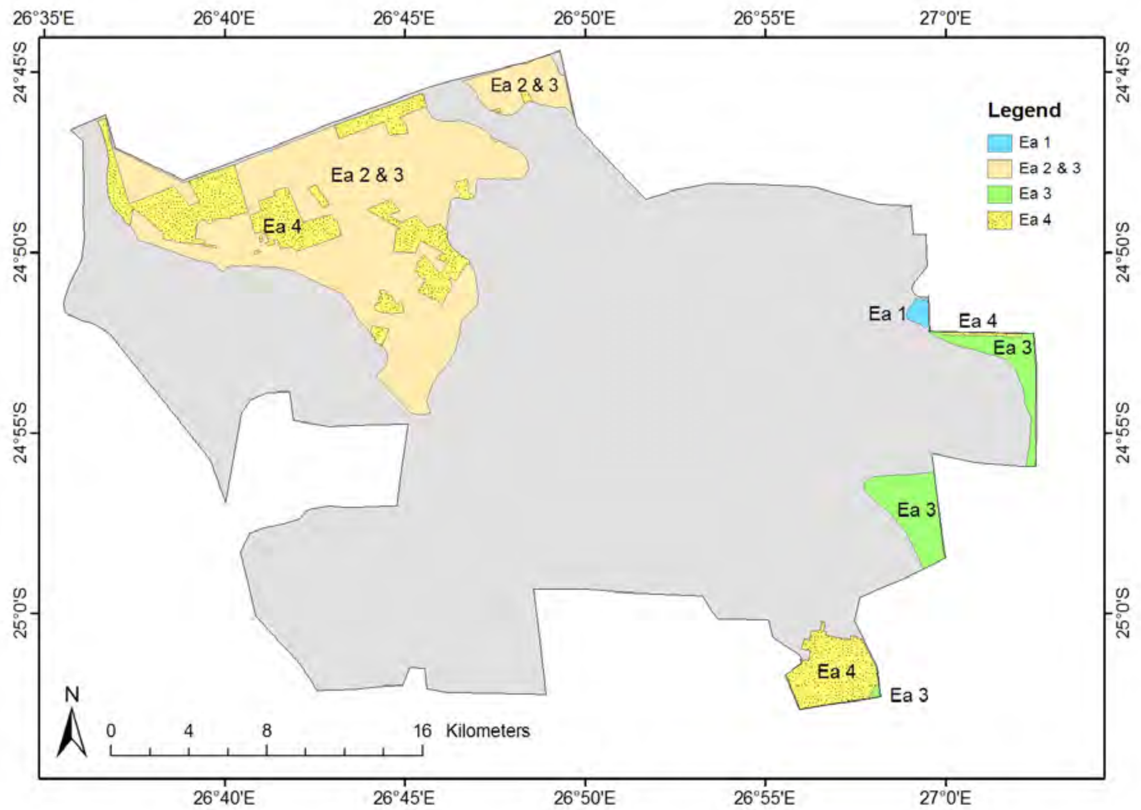

Figure 5.1 Map showing the communities of the Ea land type. Community 4 was found on old cultivated fields, on vertic clay soil.

5.3 Description of plant communities

All the species and species groups that will be referred to are included in Table 5.1. The values given for anthropogenic influences, such as bush thickening and disturbance are averages for the community or sub-community being discussed. This is also the case in the description of the physiognomy of each community. Some species were only recorded once or a few times with a low cover abundance or they were not confined to a specific species group. These species were not included in Table 5.1, but they are given in Table 5.6 at the end of this Chapter.

1. *Peltophorum africanum - Urochloa mosambicensis* Community

The *Peltophorum africanum - Urochloa mosambicensis* Community (Figure 5.2) was found on calcareous sandy loam soil with moderate disturbance. This community was located on the farm Witfontein in the eastern part of the study area on footslopes. Only four relevés were completed in this community as only a small part of it was left over. Most of the area of this community was used for crop production. The areas sampled consisted of relatively small patches of natural vegetation surrounded by cultivated lands. The soil forms found in this community are Hutton, Shortlands, Bainsvlei and Glenrosa. Particle distribution for particles smaller than 2 mm was: sand = 72.7 %, silt = 14.6 % and clay = 12.7 %. Particles larger than 2 mm made up 0.4 % of the soil. The average clay percentage was considerably lower than most of the other communities in the Ea land type and the average soil depth was 73 cm. Moderate to high levels of overgrazing and low to moderate levels of sheet erosion were recorded. Bush thickening was 55 %.

Figure 5.2 The *Peltophorum africanum* - *Urochloa mosambicensis* Community (Community 1) of the Ea land type. GPS reading: lat 24°51'24.2"S, long 26°59'19.2"E. Note the high percentage cover of the tree stratum.

The diagnostic species for the *Peltophorum africanum* - *Urochloa mosambicensis* Community are found in species group A and they included the perennial grasses *Urochloa mosambicensis* and *Panicum maximum*, the tree *Peltophorum africanum*, the shrubs *Lippia javanica* and *Diospyros lycioides* and the annual forbs *Sida cordifolia* and *Spermacoce senensis*. This community was also characterised by the absence of the species from species group L. Dominant species were *Urochloa mosambicensis, Peltophorum africanum, Lippia javanica* (species group A) and the tree *Ziziphus mucronata* (species group H). An average of 60 species was recorded per relevé and of all the species that were recorded in this community 8 % were aliens. Two protected trees, *Combretum imberbe* and *Sclerocarya birrea* (Department of Water Affairs and Forestry, 2007) were found in this community.

The grass and tree strata in this community were well developed with covers of 53 % and 51 % respectively. The high tree cover can be attributed to bush thickening. The forb and shrub strata had covers of 35 % and 28 % respectively. The tree stratum was 5.3 m in height, which was the highest of all the communities. The height of the grass and forb strata were 0.4 m and it was 1.4 m for the shrub stratum.

2. *Melhania virescens* - *Tarchonanthus camphoratus* Community

This community was found on calcareous sandy loam soil on foot- and midslopes. It was less disturbed than Community 1. The soil was shallower, with an average depth of 58 cm, than those of the other communities of the Ea land type and the soil was also sandier than the soil of Communities 3 and 4. The *Melhania virescens* - *Tarchonanthus camphoratus* Community (Figure 5.3) was found in the Ea 155 land type, only in the north-western part of the study area. It was found on several soil forms namely: Brandvlei, Coega, Mispah, Rensburg, Shortlands and Augrabies. Particle distribution for particles smaller than 2 mm was: sand = 67.7 %, silt = 15.4 % and clay = 16.9 %. Particles larger than 2 mm made up 8.3 % of the soil. Disturbance, such as overgrazing and bush thickening was higher in this community than in Communities 3 and 4 and bush thickening was 55 %.

Figure 5.3 The *Melhania virescens* - *Tarchonanthus camphoratus* Community (Community 2) of the Ea land type. GPS reading: lat 24°47'26.5"S, long 26°47'25.1"E. The shrub stratum in this community had a higher percentage cover than in the other communities.

The diagnostic species for this community could be found in species group B. They included the trees *Tarchonanthus camphoratus* and *Combretum hereroense*, the perennial herbs *Melhania virescens, Indigofera zeyheri* and *Indigofera heterotricha* and the annual herb *Kyphocarpa angustifolia*. This sub-community was also characterised by the absence of the species in species groups A and F. The dominant species for this community were the tree *Tarchonanthus camphoratus* (species group B), the shrub *Grewia flava* (species group H), the perennial grasses *Heteropogon contortus* (species group E) and *Digitaria eriantha* and the annual grass *Enneapogon cenchroides* (species group H). An average of 55 species was found per relevé and 6.9 % of the species were aliens. One protected tree, *Elaeodendron transvaalensis* (Department of Water Affairs and Forestry, 2007), was found in this community.

The grass stratum dominated in this community with a cover of 44 % and it was 0.3 m in height. Unlike in the other three communities, the shrub stratum with a cover of 37 % had a higher cover than the tree stratum (29 %). The high cover of the shrub stratum was a result of bush thickening. The height of the shrub stratum was 1.4 m and the height of the tree stratum was 3.7 m. The forb stratum had a percentage cover of 22 % with a height of 0.4 m.

This community could be divided into two sub-communities. There are clear differences between the environmental variables of the two sub-communities.

2.1 *Chrysopogon serrulatus* - *Tarchonanthus camphoratus* Sub-community

The *Chrysopogon serrulatus* - *Tarchonanthus camphoratus* Sub-community was found on sandy loam soil on footslopes. It was found on deeper, sandier and rockier soil than the *Monsonia angustifolia* - *Grewia flava* Sub-community (Community 2.2). The magnesium concentration in the soil was also lower than for the other communities (161 mg/kg). The average rockiness on the soil surface was 7.4 % and the soil had an average depth of 73 cm. Particle distribution for particles smaller than 2 mm was: sand = 76.2 %, silt = 13.42 % and clay = 10.4 %. Particles larger than 2 mm made up 15.8 % of the soil. This sub-community was found on Brandvlei, Coega and Augrabies soil forms, which are all soil forms with a carbonate B-horizon.

One of the relevés (86) from site 44 fell into this sub-community and the other relevé (87) fell into sub community 2.2. This is the only relevé pair of the Ea land type that did not fall into the same community.

This sub-community was located on the farm Jakhalskraal, which belongs to the PPC cement mining company. There was little grazing over the past fifteen years on this area. There were therefore very little signs of overgrazing, compaction and erosion. Bush thickening was 42 %.

The sub-community was characterised by the perennial grass *Chrysopogon serrulatus*, the perennial herbs *Geigeria burkei* and *Aptosimum lineare*, the perennial dwarf shrub *Clerodendrum suffruticosum* var. *suffruticosum* and the tree *Pappea capensis* (species group C). This sub-community was further characterised by the absence of the species in species groups A and K. The dominant species were the tree *Tarchonanthus camphoratus* (species group B), the perennial grass *Heteropogon contortus* (species group E) and the annual grass *Enneapogon cenchroides* (species group H). 7.4 % of the species were aliens.

The grass stratum was well developed in this sub-community, with a cover of 43 % and it was 0.4 m tall. The tree stratum had a cover of 27 % and it was 3.6 m high, the shrub stratum had a cover of 30 % and a height of 1.6 m and the forb stratum had a cover of 24 % and a height of 0.3 m.

2.2 *Monsonia angustifolia* - *Grewia flava* Sub-community

This sub-community was found on shallow, sandy clay loam soil on foot- and midslopes. The soil was more clayey than those of Sub-community 2.1, disturbance was higher and the percentage rocks on the soil surface were lower (less than 1 %). This sub-community was located on the farm Gansvley, on the Rensburg, Mispah and Augrabies soil forms. Particle distribution for particles smaller than 2 mm was: sand = 59.3 %, silt = 17.4 % and clay = 23.4 %. Particles larger than 2 mm made up 0.9 % of the soil. Average soil depth was 42 cm, which is markedly shallower than those of Community 2.1. There was moderate to high levels of overgrazing, moderate compaction and high bush thickening (68 %).

The diagnostic species for this sub-community fall into species group D. Diagnostic species were the perennial climber *Rhynchosia densiflora* subsp. *chrysandenia*, the annual herb *Monsonia angustifolia* and the perennial grass *Cymbopogon nardus*. This sub-community was however better characterised by the absence of the species in species groups A, C and F. The dominant species in this sub-community were the shrub *Grewia flava* (species group H), the perennial grasses *Digitaria eriantha* (species group H) and *Heteropogon contortus* (species group E) and the trees *Acacia caffra* (species group E) and *Acacia karroo* (species group M). Of all the species recorded, 6.3 % were aliens.

The grass and shrub strata almost had similar covers of 45 % and 43 % respectively and heights of 0.3 m and 1.4 m. The tree stratum had a cover of 30 % and it was 3.7 m tall. The forb stratum had a cover of 20 % and a height of 0.5 m. The forb stratum was higher than the grass stratum because of the presence of *Rhynchosia densiflora* subsp. *chrysandenial*, which is a climber.

The *Cymbopogon validus* (*Cymbopogon nardus*) – *Acacia nilotica* Short Open Treeveld (Kort Oop Boomveld) community described by Pauw (1988) was somewhat similar to Communities 1 and 2 of the Ea land type, with several of the same diagnostic and dominant species.

3. *Ischaemum afrum* - *Brachiaria eruciformis* Community

The *Ischaemum afrum* - *Brachiaria eruciformis* Community was found on calcareous vertic black clay soil on footslopes. According to Van der Meulen (1979), these soil are derived from norite and gabbros and are usually called “black turf”. They have a neutral to alkaline pH (Van der Meulen, 1979), with an average of 7.6 in this study. Arcadia soil have self-mulching properties and forms cracks when drying out (Van der Meulen, 1979). Soil in this community were deeper and more clayey than those of Communities 1 and 2. This community was found mostly on the Rensburg soil form, which consists of a vertic A-horizon on a G-horizon (Soil classification workgroup ARC, 1991). Particle distribution for particles smaller than 2 mm was: sand = 47 %, silt = 17.4 % and clay = 35.6 %. Particles larger than 2 mm made up 1.6 % of the soil. Average soil depth was 110 cm. There was little overgrazing and bush thickening (23%) visible in this community.

The diagnostic species for this community included the perennial grasses *Ischaemum afrum* and *Urelytrum agropyroides*, the shrub *Ocimum labiatum*, the annual grass *Panicum schinzii* and the tree *Rhus pyroides* (species group F). This community was further characterised by the absence of species groups E and J. The dominant species were the annual grass *Brachiaria eruciformis* (species group K) and the perennial grasses *Setaria incrassata* (species group K), *Ischaemum afrum* (species group F) and *Cymbopogon pospischilii* (species group M). An average of 38 species was recorded per relevé and 6 % of the species recorded were aliens.

The name of this community may create the impression that it is grassland. This is however not the case, it can be described a sparse woodland. Two grasses were used in the name as they described the community best, because of their dominance and high cover. The grass stratum was very well developed, with a cover of 56 % and a height of 0.5 m. The tree stratum had a cover of 22 % and it was 3.8 m tall. The shrub stratum had a cover of 15 % and a height of 1.1 m and the forb stratum had a cover of 18 % and a height of 0.4 m.

A similar association has been described by Van der Meulen (1979), namely the *Acacia tortilis* – *Aristida bipartita* Woodland Association which was found on vertic black clays of the Arcadia soil form. A similar community has also been described by Pauw (1988), namely the *Ischaemum afrum* – *Acacia tenuispina* Low Open Treeveld (Lae Oop Boomveld). This community was also found on vertic black clays, with a clay percentage of more than 55 %.

The *Ischaemum afrum* - *Brachiaria eruciformis* Community could be divided into two sub-communities based on species composition.

3.1 *Asparagus suaveolens - Acacia nilotica* Sub-community

The *Asparagus suaveolens* - *Acacia nilotica* Sub-community (Figure 5.4) was spread throughout the Ea land type and was found on several farms on clay soil. The soil in Sub-community 3.1 had a higher base saturation and pH than Sub-community 3.2 (see Figure 5.8).

Particle distribution for particles smaller than 2 mm was: sand = 38.3 %, silt = 23.4 % and clay = 38.3 %. Particles larger than 2 mm made up 2.4 % of the soil. There was little disturbance and some bush thickening (25 %). Bush thickening was slightly higher in this sub-community, than in Sub-community 3.2 and less overgrazing has been noted in this sub-community.

Figure 5.4 The *Asparagus suaveolens* - *Acacia nilotica* Sub-community (Sub-community 3.1) of the Ea land type. GPS reading: lat 24°47’07.3”S, long 26°43’15.9”E. Note the dominant *Acacia* species (*A. robusta* and *A. tortilis*), and the dense grass stratum.

The diagnostic species for this sub-community can be found in species group G which included the shrub *Asparagus suaveolens*, the tree *Acacia robusta*, the perennial grass *Eragrostis chloromelas* and the annual herb *Ipomoea gracilisepala*. This sub-community was further characterised by the absence of species groups F, I and J. Dominant species include the trees *Acacia nilotica* (species group H) and *Acacia robusta* (species group G), the perennial grass *Digitaria eriantha* (species group H), the annual grass *Brachiaria eruciformis* (species group K) and the shrub *Grewia flava* (species group H). An average of 42 species was recorded per relevé. Of all the species recorded 8.2 % were aliens. The protected tree *Sclerocarya birrea* (Department of Water Affairs and Forestry, 2007) was found in this sub-community.

The grass stratum formed the dominant stratum, with a cover of 58 % and a height of 0.6 m. The tree stratum had a cover of 29 % and a height of 4.1 m. The shrub stratum had a cover of 18 % and a height of 1.2 m and the forb stratum had a cover of 23 % and it was 0.5 m high.

3.2 *Aspilia mossambicensis* - *Acacia karroo* Sub-community

The *Aspilia mossambicensis* - *Acacia karroo* Sub-community (Figure 5.5) was found on the farms Jakhalskraal and Gansvley on clay soil. Potassium concentration was lower in this community than in the other communities (64.5 mg/kg). Particle distribution for particles smaller than 2 mm was: sand = 55.6 %, silt = 11.4 % and clay = 32.9 %. Particles larger than 2 mm made up 0.7 % of the soil. The soil of this sub-community had higher percentage sand than the soil of Sub-community 3.1. The species composition and structure of the two sub-communities varied considerably

Figure 5.5 The *Aspilia mossambicensis* - *Acacia karroo* Sub-community (Sub-community 3.2) of the Ea land type. GPS reading: lat 24°56'28.3"S, long 27°59'31.3"E. Note the *Acacia karroo* trees, which distinguish it from the *Asparagus suaveolens* - *Acacia nilotica* Sub-community (Sub-community 3.1). The tree stratum had an average percentage cover of 10 % for this community, which is much less than for most of the other communities.

The diagnostic species for this sub-community included the perennial herb *Aspilia mossambicensis*, the shrub *Asparagus laricinus* and the perennial grasses *Themeda triandra* and *Aristida diffusa* (species group I). This community was further characterised by the absence of species groups H and J. The dominant species included the perennial grasses *Setaria incrassata, Bothriochloa insculpta* and *Eragrostis curvula* (species group K), the perennial herb *Aspilia mossambicensis* (species group I) and the tree *Acacia karroo* (species group M). An average of 34 species was recorded per relevé and 3.8 % of the species were aliens. The species richness as well as the percentage alien species for this sub-community was considerably lower than those of Sub-community 3.2.

The grass stratum formed the dominant stratum, with a cover of 54 % and a height of 0.4 m. The tree stratum had a cover of 10 %, which was a third of the cover of the trees in Sub-community 3.2. The tree stratum was 3.2 m tall. The shrub and forb strata had covers of 10 % and 11 % and heights of 0.9 m and 0.3 m respectively.

4. *Sorghum versicolor* - *Bothriochloa insculpta* Community

The *Sorghum versicolor* - *Bothriochloa insculpta* Community was found on old cultivated lands, on calcareous deep (average 104 cm) sandy clay soil on footslopes (Figure 5.6). It was located on the farms Jakhalskraal and Gansvley. Communities 3 and 4 were similar in terms of species composition and environmental variables. Community 4 was however found on old cultivated lands and many of the species found in Community 3 were absent from Community 4. The land had some time to recover after crop production has seized (approximately fifteen years), but not all the species have re-established yet. It is possible that they might re-establish in the years to come and that Communities 3 and 4 will then be regarded as one community. For the time being however, the difference between the two communities was large enough to treat them as two separate communities.

Figure 5.6 The *Sorghum versicolor* - *Bothriochloa insculpta* Community (Community 4) of the Ea land type. GPS reading: lat 24°50'41.8"S, long 26°45'32.7"E. This community was found on old cultivated fields. The tree stratum had an average percentage cover of a mere 7 %.

This community was found exclusively on the Rensburg soil form. Particle distribution for particles smaller than 2 mm was: sand = 51.2 %, silt = 9.1 % and clay = 39.7 %. Particles larger than 2 mm made up 0.9 % of the soil. Bush thickening was 42 %, but no other disturbances such as overgrazing or erosion were recorded.

The diagnostic species for this community were the perennial grasses *Sorghum versicolor* and *Cenchrus ciliaris* (species group J). This community was further characterised by the absence of species groups F and I. The dominant species for this group includes the perennial grasses *Setaria incrassata and Bothriochloa insculpta* (species group K), the tree *Dichrostachys cinerea* and the perennial herb *Rhynchosia minima* (species group M). An average of 26 species was recorded per relevé, which was the lowest of all the communities in the Ea land type. A total of 14.3 % of the species recorded were aliens, which is a result of previous disturbance. The protected tree *Sclerocarya birrea* (Department of Water Affairs and Forestry, 2007) was found once in this community.

Once again the grass stratum was well developed, with a cover of 53 % and a height of 0.6 m. The tree stratum had a cover of 7 % and it was 2.7 m high. Both the cover and the height of the tree stratum was the lowest of all the communities in the Ea land type, as trees were removed during crop production. The shrub stratum had a cover of 10 % and a height of 1.3 m and the forb stratum had a cover of 16 % and a height of 0.4 m.

A somewhat similar community has been described by Pauw (1988), namely the *Ischaemum afrum – Acacia tenuispina* Low Open Treeveld (Lae Oop Boomveld). This community was also found on vertic black clays, with a high clay percentage.

Vegetation surveys were carried out by Zacharias (1994) on old cultivated lands in the Madikwe Game Reserve where *Cenchrus ciliaris* was over sown. This was most likely what happened in certain areas of the *Sorghum versicolor - Bothriochloa insculpta* Community as well. These *Cenchrus ciliaris* stands might provide a valuable source of forage in the future as it is a palatable grass (Van Oudtshoorn, 2004).

5.4 Ordinations

Correspondence Analysis (CA) and Principal Component Analysis (PCA) ordinations were carried out to determine the correlation between the species data and the environmental data of the different communities of the Ea land type. Quantitative environmental variables, such as soil depth and clay percentage were indicated by arrows, which reflected certain gradients.

In the first CA ordination (Figure 5.7), Community 1 could clearly be distinguished from the other three communities, due to the unique species composition. The first ordination axis had a strong negative correlation with clay percentage with a correlation coefficient of -0.6 (Table 5.2). According to this ordination, Communities 3 and 4 are characterised by higher clay percentage and deeper soil than Communities 1 and 2 in the Ea land type. Community 1 was correlated with a higher percentage bush thickening than the other three communities and Community 2 was characterised by a higher percentage rocks on the soil surface (Figure 5.7).

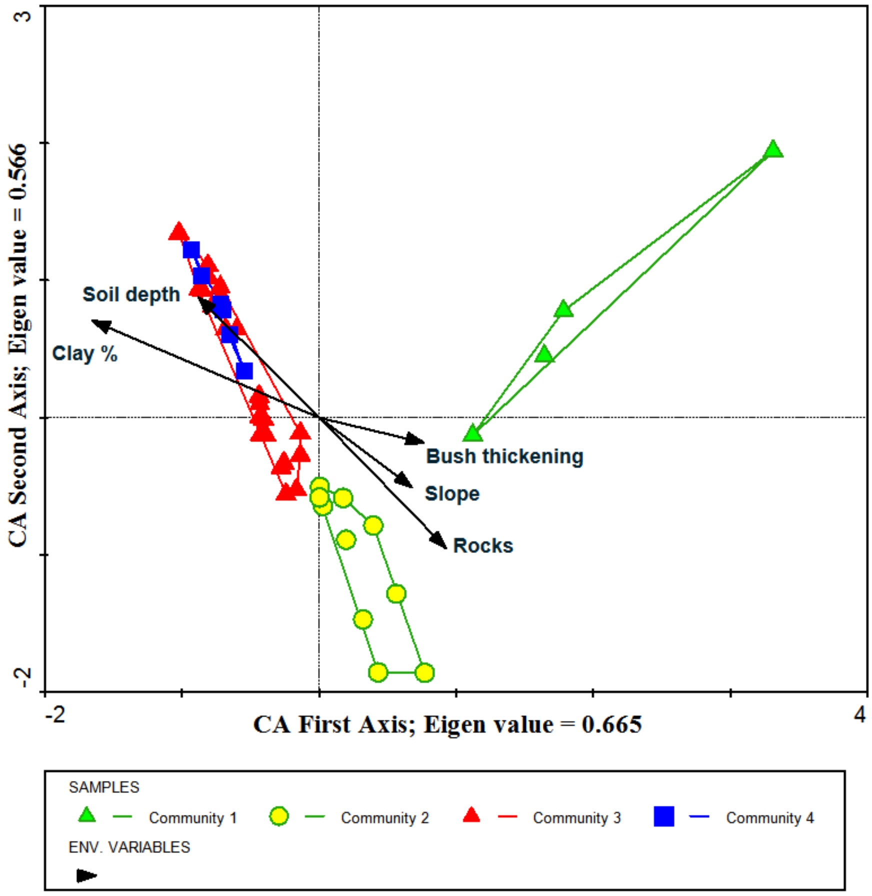

Figure 5.7 CA ordination biplot of all the communities (1 to 4) of the Ea land type, showing environmental variables and samples/relevés. The *Peltophorum africanum* - *Urochloa mosambicensis* Community (1), the *Melhania virescens* - *Tarchonanthus camphoratus* Community (2), the *Ischaemum afrum* - *Brachiaria eruciformis* Community (3) and the *Sorghum versicolor* - *Bothriochloa insculpta* Community (4) are shown in this biplot.

Table 5.2 Correlation coefficients of environmental factors of Figure 5.7.

Environmental Factor	Ordination Axis 1	Ordination Axis 2
Clay %	-0.5979	0.2660
Soil depth	-0.3196	0.3304
Bush thickening	0.2752	-0.0684
Slope	0.2443	-0.1905
Rocks	0.3341	-0.3577

Another CA ordination (Figure 5.8) was carried out to investigate the differences between Communities 2, 3 and 4, according to the environmental factors mentioned above. The correlation coefficients for this ordination are given in Table 5.3. There were strong negative correlations between the first ordination axis and clay percentage and soil depth of -0.62 and -0.5 respectively (Table 5.3). This confirmed that Communities 3 and 4 were found on deeper, more clayey soil than Community 2. The first ordination axis was also correlated with percentage rocks on the soil surface, with a correlation coefficient of 0.52. Community 2 therefore had a higher percentage rocks on the soil surface, than Communities 3 and 4. Bush thickening and slope was negatively correlated with ordination axis 2, with correlation coefficients of -0.37 and -0.32 respectively. This indicated that there was more bush thickening in Community 2 than in Communities 3 and 4. Community 2 was also found on steeper slopes.

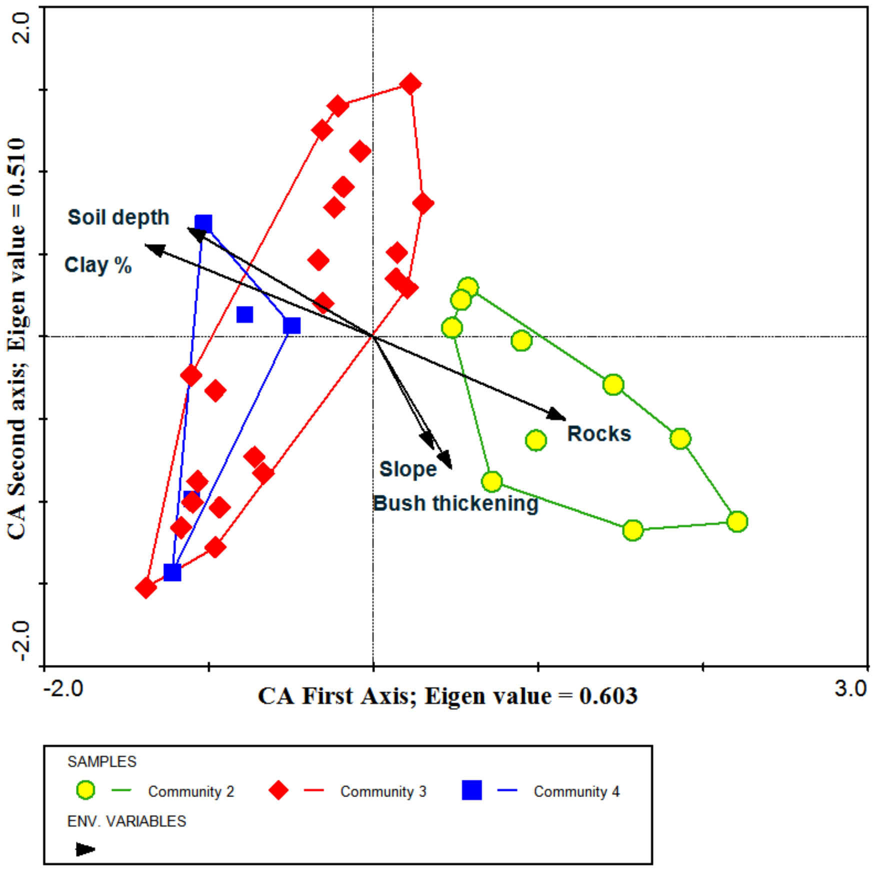

Figure 5.8 CA ordination biplot showing environmental variables and samples/relevés of communities 2 to 4 of the Ea land type: the *Melhania virescens* - *Tarchonanthus camphoratus* Community (2), the *Ischaemum afrum* - *Brachiaria eruciformis* Community (3) and the *Sorghum versicolor* - *Bothriochloa insculpta* Community (4). Community 2 (green and yellow) was clearly different from Communities 3 and 4 (red and blue).

Table 5.3 Correlation coefficients of environmental factors of Figure 5.8.

Environmental Factor	Ordination Axis 1	Ordination Axis 2
Clay %	-0.6152	0.2588
Soil depth	-0.5019	0.3052
Bush thickening	0.2095	-0.3722
Slope	0.1608	-0.3164
Rocks	0.5182	-0.2345

To indicate the difference between Sub-community 2.1 and Sub-community 2.2, another CA ordination was carried out including only Community 2 (Figure 5.9). Ordination axis 1 was strongly correlated with slope (0.61) and also had a strong negative correlation with percentage rocks on the soil surface and soil depth (-0.63 and -0.5 respectively) (Table 5.4). This showed that Sub-community 2.1 was found on deeper soil with a higher percentage rocks on the soil surface than Sub-community 2.2.

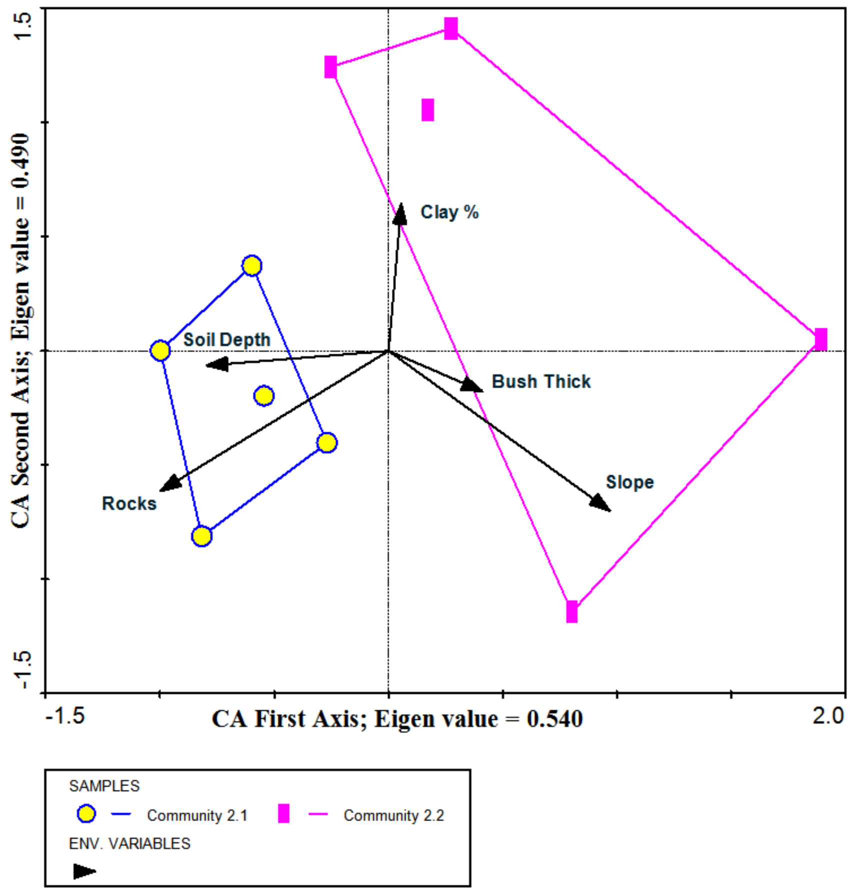

Figure 5.9 CA ordination biplot showing environmental variables and samples/relevés of the Ea land type, Sub-communities 2.1 and 2.2: the *Chrysopogon serrulatus - Tarchonanthus camphoratus* Sub-community (2.1) and the *Monsonia angustifolia - Grewia flava* Sub-community (2.2).

Table 5.4 Correlation coefficients of environmental factors of Figure 5.9.

Environmental Factor	Ordination Axis 1	Ordination Axis 2
Clay %	0.0359	0.4158
Soil depth	-0.5015	-0.0416
Bush thickening	0.2592	-0.1154
Slope	0.6118	-0.4529
Rocks	-0.6297	-0.3966

The differences between Communities 3 and 4 were investigated by another CA ordination (Figure 5.10). Percentage rocks on the soil surface were strongly correlated with ordination axis 1 with a correlation coefficient of 0.55 (Table 5.5). Considering the distribution of the relevés from the two communities in the ordination, one can conclude that they are very similar in terms of species composition and environmental variables. Many of the species found in Community 3 were absent in Community 4, mainly due to the removal of species for the preparation of the cultivated lands for crop production. The species richness for Community 4 was very low. These two communities could therefore only be separated due to the difference in species richness and not according to the environmental factors. With time these two communities might again become one, but for the time being, the differences between then was big enough to consider them as two separate communities.

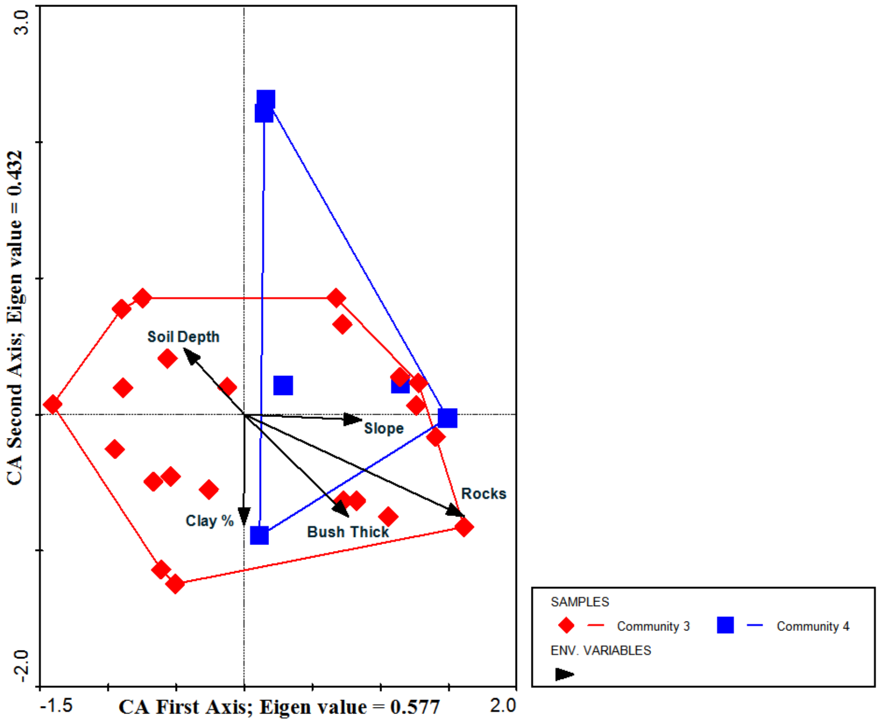

Figure 5.10 CA ordination biplot showing environmental variables and samples/relevés of Communities 3 and 4 in the Ea land type: the *Ischaemum afrum - Brachiaria eruciformis* Community (3) and the *Sorghum versicolor - Bothriochloa insculpta* Community (4).

Table 5.5 Correlation coefficients of environmental factors of Figure 5.10.

Environmental Factor	Ordination Axis 1	Ordination Axis 2
Clay %	-0.0009	-0.2980
Soil depth	-0.1508	0.1774
Bush thickening	0.2611	-0.2757
Slope	0.2931	-0.0155
Rocks	0.5493	-0.2740

The soil analyses indicated that Community 1 was found on leached sandy soil with a low base saturation. Sub-community 2.1 was also found on more sandy soil and Sub-community 2.2 on more clayey soil. Communities 3 and 4 were found on clayey soil with a high base saturation, CEC and pH. Sub-community 3.1 however, had a higher base saturation and pH than Sub-community 3.2 (Figure 5.11).

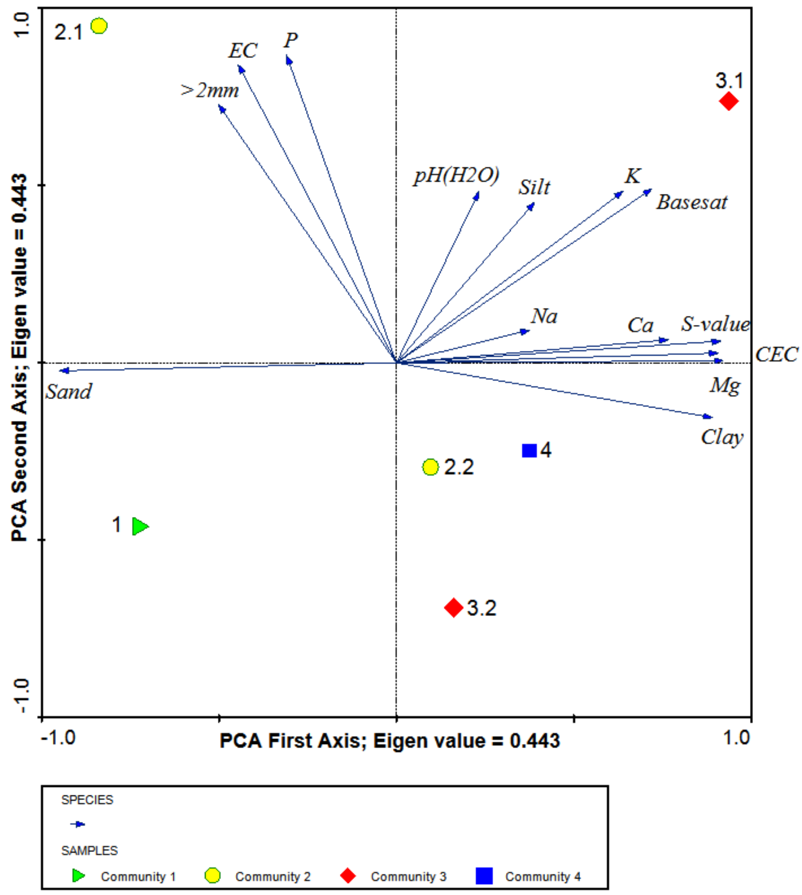

Figure 5.11 PCA ordination biplot of the data from the soil analyses at the different communities and sub-communities of the Ea land type. The following communities are shown on the graph: the *Peltophorum africanum - Urochloa mosambicensis* Community (1), the *Melhania virescens - Tarchonanthus camphoratus* Community (2): the *Chrysopogon serrulatus - Tarchonanthus camphoratus* Sub-community (2.1), the *Monsonia angustifolia - Grewia flava* Sub-community (2.2), the *Ischaemum afrum - Brachiaria eruciformis* Community (3): the *Asparagus suaveolens - Acacia nilotica* Sub-community (3.1), the *Aspilia mossambicensis - Acacia karroo* Sub-community (3.2) and the *Sorghum versicolor - Bothriochloa insculpta* Community (4).

5.5 Soil

Most of the relevés (26 out of 42 or 62 %) were found on vertic black ultramafic clay soil (Rensburg soil form). The other relevés were found on a variety of soil forms with an ortic A-horizon on respectively hard and soft carbonate B-horizons, structured and apedal red B-horizons and others. Soil analyses show that the Ea land type in the study area consists of calcareous soil with an average of 4 324 mg/kg calcium. As expected, the soil had a high pH (average 7.74) and a high base saturation. This corresponded with the description of the soil by Mucina & Rutherford (2006).

5.6 Species composition

Ninety three percent (93 %) of the species recorded in the Ea land type were indigenous and 72 % perennial. More than two thirds of the alien species were annuals and therefore did not pose a serious threat to the indigenous vegetation. The most common growth form was herbs, then shrubs and graminoids (Figure 5.12). The average species richness was 43 species per relevé.

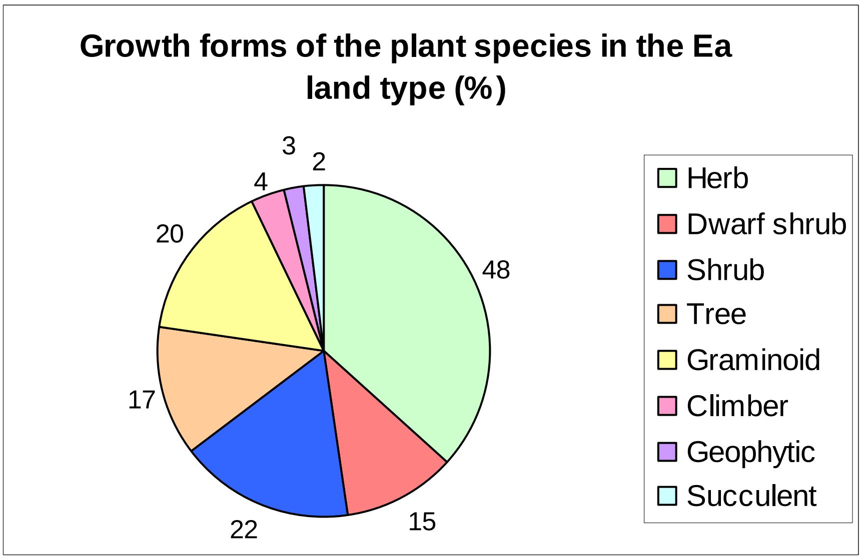

Figure 5.12 Composition of the different growth forms of the species in the Ea land type. Herbs made the greatest contribution to species richness in this community.

5.7 Conclusion

Most of the Ea land type in the Central Corridor Area (CCA) falls into the Dwaalboom Thornveld vegetation type and a smaller part falls into the Madikwe Dolomite Bushveld vegetation type described by Mucina & Rutherford (2006). A large part of this land type was found on vertic clay soil. Four communities and four sub-communities were identified and described in the Ea land type in the CCA. From the ordinations and the averages of the environmental data it could be concluded that the environmental factors that had the greatest influence on the species composition and distribution of the communities of the Ea land type, as in the Ae land type, were soil depth and clay percentage. The *Ischaemum afrum* - *Brachiaria eruciformis* Community (Community 3) and the *Sorghum versicolor* - *Bothriochloa insculpta Community* (Community 4) were found on deep, very clayey soil, while the *Peltophorum africanum* - *Urochloa mosambicensis* Community (Community 1) and the *Melhania virescens* - *Tarchonanthus camphoratus* Community (Community 2) were found on less clayey soil. Community 1 were found on the least clayey soil of all the communities and Community 2 had the highest percentage rocks on the soil surface. Community 4 was different from Community 3 because of former disturbance, as it was located on old cultivated fields. Three protected tree species: *Combretum imberbe* , *Sclerocarya birrea* and *Elaeodendron transvaalensis* were recorded in this community. Some similar communities were described by other authors. A community that was somewhat similar to Communities 1 and 2 was described by Pauw (1988) in the Atherstone

Nature Reserve. A community that was similar to Community 3 was identified and described by Van der Meulen (1979) and a community that was similar to both Communities 3 and 4 of the Ea land type was describer by Pauw (1988).

Table 5.6 List of species for the Ea land type which are not shown in Table 5.1, because they occurred only once or a few times, with a low cover abundance or they were not confined to specific communities.

Community	Species (relevé number)(cover abundance value)
1.	*Acacia burkei* (53)(b); *Acacia grandicornuta* (180)(+); **Acanthospermum hispidum* (52)(+); *Aloe marlothii* (53)(+); *Aptosimum procumbens* (181)(+); *Bulbostylis hispidula* var. *pyriformis* (52)(+); *Chamaesyce prostrata* (52)(+); **Chenopodium carinatum* (52)(+);*Commiphora mollis* (52)(+); *Crotalaria globifera* (52)(a); *Cyphostemma simulans* (180)(+); *Eragrostis biflora* (53)(+); *Gardenia volkensii* (181)(1); **Guilleminea densa* (52)(+); *Indigofera vicioides* var. *vicioides* (53)(+); *Jasminum streptopus* (180)(+); *Melhania prostrata* (53)(+); *Neorautanenia ficifolius* (52)(+); **Opuntia ficus-indica* (180)(+); *Oropetium capense* (52)(+); *Oxalis obliquifolia* (181)(+); *Philyrophilium schinzii* (53)(+); *Portulaca quadrifida* (52)(+); *Raphionacme velutina* (53)(+); *Sesamum triphyllum* (52)(+); *Stylosanthes fruticosa* (181)(+); *Terminalia sericea* (180)(+); *Tragus berteronianus* (52)(+); *Vernonia poskeana* (52)(+); *Viscum rotundifolium* (52)(+); *Zornia milneana* (52)(+)
2.	*Euclea natalensis* (79)(1), (84)(+), (85)(+)
2.1	*Acacia erubescens* (84)(1); *Barleria macrostegia* (213)(+); *Dicoma macrocephala* (86)(+); *Dicoma* species (212)(+); *Elaeodendron transvaalensis* (84)(+); *Indigofera nebrowniana* (213)(+); *Indigofera rhytidocarpa* subsp. *rhytidocarpa* (86)(+); *Pticolobium plicatum* (212)(+); *Seddera capensis* (86)(+); *Sida dregei* (212)(+); *Ximenia caffra* (212)(+)
2.2	*Aristida adscensionis* (78)(+); *Combretum apiculatum* (78)(+), (92)(1); *Eragrostis racemosa* (78)(+); *Eustachys paspaloides* (87)(+); *Hyparrhenia hirta* (79)(+), (92)(+); *Ocimum angustifolium* (70)(+); *Sphedamnocarpus pruriens* (97)(+); *Tapinanthus* species (92)(+); *Tephrosia longipes* (97)(+); *Waltheria indica* (93)(+)
3.1	*Echinochloa pyramidalis* (211)(+); *Euphorbia* species (209)(+); *Hibiscus calyphyllus* (208)(+); *Jatropha schlechteri* (208)(+); *Ledebouria apertiflora* (91)(+); *Ornithogalum* species (91)(+); *Senecio harveianus* (103)(+); *Senecio inaequidens* (102)(+), (103)(+); *Sida rhombifolia* (69)(+); Tragia *incisifolia* (211)(+); *Withania somnifera* (201)(+); *Tephrosia purpurea* subsp. *leptostachya* var. *leptostachya* (208)(+), (209)(+)
3.2	*Acacia galpinii* (101)(+); *Chamaecrista mimosoides* (100)(1), (101)(+); *Crinum graminicola* (177)(+), *Gladiolus permeabilis* (100)(+), (101)(+); *Helianthus annuus* (176)(+); *Jatropha zeyheri* (174)(+), (176)(+)

4	**Datura ferox* (88)(+), (89)(+); *Ipomoea obscura* (89)(+); *Ischaemum fasciculatum* (89)(+); *Merremia verecunda* (95)(+); *Panicum volutans* (88)(1), (89)(a); **Physalis angulata* (94)(+); *Solanum nigrum* (88)(+)
No specific community	*Acacia mellifera* (68)(+), (85)(+), (93)(+), (208)(+), (213)(+); *Aloe greatheadii* (92)(+), (180)(+); *Aristida rhiniochloa* (90)(+), (92)(1), (95)(+), (210)(+), (211)(+); **Bidens pilosa* (85)(+), (211)(+); *Blepharis integrifolia* (69)(+), (95)(+); *Blepharis maderaspatensis* (210)(+), (213)(+); *Brachiaria deflexa* (53)(+), (206)(1); *Commelina benghalensis* (52)(+), (85)(+), (177)(+), (206)(+), (208)(+); *Elephantorrhiza elephantina* (92)(+), (93)(+), (175)(+), (179)(+); *Eragrostis nindensis* (74)(+), (87)(+); *Eragrostis superba* (181)(+), (212)(+); **Flaveria bidentis* (84)(+), (88)(+), (89)(+), (95)(+); *Heliotropium steudneri* (201)(+), (212)(+); *Hermbstaedtia linearis* (64)(+), (84)(+); *Hibiscus pusillus* (87)(+), (178)(+), (206)(+); *Indigofera daleoides* (52)(+), (84)(+), (85)(+), (174)(+), (208)(+), (209)(+); *Ipomoea papilio* (92)(+), (93)(+), (94)(+), (95)(+); *Kohautia amatymbica* (52)(+), (86)(+), (100)(+), (176)(+), (177)(+), (208)(+), (209)(+); *Leucas capensis* (207)(+), (210)(+), (213)(+); *Momordica balsamina* (52)(+), (103)(+); *Phyllanthus incurvus* (78)(+), (79)(+), (100)(+), (103)(+), (174)(+), (176)(+), (177)(+), (181)(+); *Phyllanthus maderaspatensis* (75)(+), (91)(+), (207)(+), (212)(+), (213)(+); Sclerocarya birrea (90)(+), (181)(+), (199)(+); *Sesbania transvaalens* (86)(+), (95)(a); *Sporobolus nitens* (79)(+), (181)(+); *Striga forbesii* (197)(+), (198)(+); *Thesium utile* (178)(+), (212)(+) * Alien species

Chapter 6
Classification and description of the Fa land type

6.1 Introduction

The Fa land type covers the second largest surface area of all the land types in the Central Corridor Area (CCA). A total of 24 sites and 48 relevés were completed for this land type. There was only one Fa land type in the study area, namely the Fa 293 land type (Figure 2.2). The whole area was used for cattle grazing, as the shallow soil is not suitable for crop production.

The F land types were intended to accommodate pedologically young landscapes that are not predominantly rock and not predominantly alluvial or aeolian. The dominant soil forming processes have been rock weathering, the formation of orthic topsoil horizons and commonly clay illuviation, giving rise typically to lithocutanic horizons. The Mispah and Glenrosa soil forms are found most frequently in these land types. Shallow and deep soil of the Oakleaf soil form (usually on upland sites) developed by rock weathering are accommodated here. Fa refers to land where lime in the soil is not encountered regularly in any part of the landscape (Land Type Survey Staff, 1988).

The Fa land type in the CCA fell into the Madikwe Dolomite Bushveld vegetation type described by Mucina & Rutherford (2006) This vegetation type was described as a vegetation type where the tree and shrub strata are often not clearly distinct, especially on steeper slopes. It is dominated by broad-leaved, deciduous trees, particularly *Combretum apiculatum* and *Kirkia wilmsii*. The herbaceous stratum is continuous and dominated by grasses.

The soil of this vegetation type are typically stony shallow soil of Glenrosa and Mispah forms underlain mainly by dolomite, subordinate chert, minor calcareous shale, limestone and quartzite of the Malmani Subgroup (Chuniespoort Group, Transvaal Supergroup, Vaalian Erathem) (Mucina & Rutherford, 2006).

6.2 Plant communities of the Fa land type

The Fa land type includes the following four communities and four sub-communities (Figure 6.1, Table 6.1), namely:

1. *Lippia javanica - Vitex zeyheri* Community
2. *Tarchonanthus camphoratus - Acacia caffra* Community
    - 2.1 *Acacia karroo - Acacia caffra* Sub-community
    - 2.2 *Brachiaria nigropedata - Digitaria eriantha* Sub-community
3. *Indigofera filipes - Combretum apiculatum* Community
    - 3.1 *Clerodendrum suffruticosum* var. *suffruticosum - Sclerocarya birrea* Sub-community
    - 3.2 *Monsonia angustifolia - Dichrostachys cinerea* Sub-community
4. *Pappea capensis - Kirkia wilmsii* Community

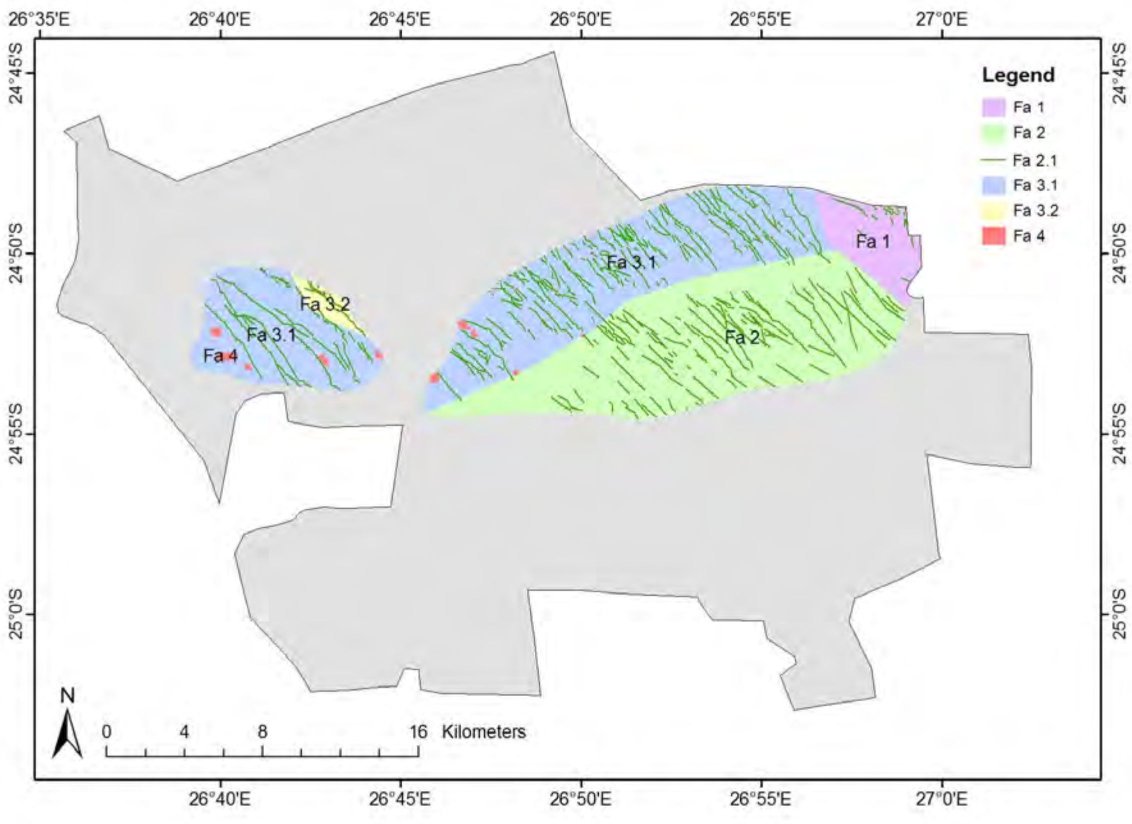

Figure 6.1 Map showing the communities of the Fa land type. Sub-community 2.1 could clearly be seen on the aerial photographs as strips in the other communities. Community 4 were found on hills in the otherwise relatively even landscape.

Table 6.1 Phytosociological table of the Fa land type of the Central Corridor Area of the proposed Heritage Park

																																															1	1
Site number	2	2	9	9	9	9	1	1	1	1	2	1	1	1	1	1	2	2	2	2	2	2	2								1	1	2	2	2	2	3	3		1	1	3	3	1	3	3	0	0
	3	3	2	2	3	3	1	1	4	4	6	2	2	3	3	8	1	1	4	4	5	5	6	4	4	5	5	6	8	8	7	8	0	0	2	2	6	6	6	9	9	9	9	7	7	7	8	8
Relevé number			1	1	1	1																																									2	2
	4	4	8	8	8	8	2	2	2	2	5	2	2	2	2	3	4	4	4	4	4	4	5				1	1	1	1	3	3	3	3	4	4	7	7	1	3	3	7	7	3	7	7	1	1
	4	5	2	3	4	5	1	2	7	8	1	3	4	5	6	4	0	1	6	7	8	9	0	7	8	9	0	1	5	6	2	5	8	9	2	3	0	1	2	6	7	6	7	3	2	3	4	5
Number of species per relevé	4	6	6	6	5	5	4	6	6	4	5	5	7	5	6	5	5	5	5	5	4	4	6	5	4	5	4	5	5	5	5	4	5	5	5	4	5	5	4	6	6	4	7	5	4	4	5	6
	9	2	4	2	5	0	5	7	6	6	0	9	2	9	7	1	8	9	4	6	4	5	4	7	4	9	6	8	3	2	4	3	8	6	4	7	0	8	8	0	2	9	1	0	5	6	9	0
Community	1						2.1					2.2												3.1															3.2					4				
Species group A (Diagnostic species of Community 1)																																																
Lippia javanica	+	1	a	+	+	+	.	.	.	.	+	.	.	.	.	.	.	.	+	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
Aptosimum lineare	+	+	1	+	+	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Acacia nilotica	+	.	+	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.
Hyparrhenia hirta	a	1	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hibiscus trionum	+	+	.	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	+	.	.	.	.	.
Dicoma macrocephala	+	+	.	+	+	.	.	.	.	.	.	+	+	.	+	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Evolvulus alsinoides	.	.	1	+	+	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	+	.	.	.	
Pollichia campestris	.	.	+	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Spermacoce senensis	.	.	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Seddera suffruticosa	.	.	.	.	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Jamesbrittenia burkeana	.	.	.	.	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Melhania acuminata	.	.	.	.	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Jamesbrittenia atropurpurpurea	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hermannia boraginiflora	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Indigofera circinnata	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
**Salvia reflexa*	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Indigofera charliriana v. *charliriana*	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.
Lippia rehmannii	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Microchloa caffra	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Zornia milneana	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Xenostegia tridentata	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ipomoea gracilisepala	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.
Chlorophytum species	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Gladiolus permeabilis	.	.	+	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Blepharis integrifolia	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Indigastrum costatum s. *macrum*	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Geigeria burkei	.	.	.	.	+	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Table 6.1 (continued)																																																
Relevé number			1	1	1	1																																									2	2
	4	4	8	8	8	8	2	2	2	2	5	2	2	2	2	3	4	4	4	4	4	4	5				1	1	1	1	3	3	3	3	4	4	7	7	1	3	3	7	7	3	7	7	1	1
	4	5	2	3	4	5	1	2	7	8	1	3	4	5	6	4	0	1	6	7	8	9	0	7	8	9	0	1	5	6	2	5	8	9	2	3	0	1	2	6	7	6	7	3	2	3	4	5
Community	1						2.1					2.2												3.1															3.2					4				
Species group B (Diagnostic species of Community 2)																																																
Tarchonanthus camphoratus	.	.	.	.	.	+	+	+	+	.	+	+	+	+	+	+	.	.	.	1	+	+	.	.	.	+	.	.	.	.	.	.	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Eragrostis superba	+	1	.	.	.	.	.	+	+	+	+	+	.	.	+	.	.	+	b	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.
Eustachys paspaloides	.	+	.	.	+	.	+	+	+	1	+	.	.	+	+	+	.	.	+	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.
Chascanum hederaceum	.	.	+	.	.	.	.	+	+	+	+	.	.	+	.	.	+	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.
Phyllanthus parvulus	.	.	.	.	.	.	.	.	+	.	.	+	+	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+
Dicoma anomala	+	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	+	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Clematis brachiata	.	+	.	.	.	.	.	.	.	a	a	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.
Asparagus suaveolens	.	.	.	.	.	.	+	.	+	.	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cymbopogon pospischilii	.	.	.	.	.	.	.	+	+	+	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.
Boophone disticha	.	.	.	.	.	.	.	.	.	.	+	.	.	r	.	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sida dregei	.	.	+	.	.	.	.	+	+	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Species group C (Diagnostic species of Sub-community 2.1)																																																
Acacia karroo	.	.	.	.	+	1	1	+	1	1	+	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.
Withania somnifera	+	.	.	.	.	.	+	+	+	b	+	.	.	.	+	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sida spinosa	.	.	.	.	.	.	+	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+	.	.	.	.	.
Themeda triandra	.	.	.	.	.	.	.	.	+	1	b	.	.	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ziziphus zeyheriana	.	.	.	.	.	.	.	+	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Chloris virgata	.	.	.	.	.	.	+	+	+	.	.	.	+	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Eragrostis racemosa	.	.	.	.	.	.	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.
Vernonia oligocephala	.	.	.	.	.	.	+	.	+	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Oxalis obliquifolia	.	.	.	.	.	.	.	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	.	.	.	.	.	.	.
Crabbea angustifolia	.	.	.	.	.	.	+	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Solanum tettense v. *renschii*	.	.	.	.	.	.	+	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Aristida congesta s. *barbicollis*	.	.	.	.	.	.	.	+	.	+	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.

Table 6.1 (continued)

Relevé number			1	1	1	1																																									2	2
	4	4	8	8	8	8	2	2	2	2	5	2	2	2	2	3	4	4	4	4	4	4	5				1	1	1	1	3	3	3	3	4	4	7	7	1	3	3	7	7	3	7	7	1	1
	4	5	2	3	4	5	1	2	7	8	1	3	4	5	6	4	0	1	6	7	8	9	0	7	8	9	0	1	5	6	2	5	8	9	2	3	0	1	2	6	7	6	7	3	2	3	4	5
Community	1						2.1					2.2												3.1															3.2					4				
Species group D																																																
Ziziphus mucronata	.	.	+	+	+	+	+	b	+	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	+	.	.	.	1	+
Rhus leptodictya	.	+	+	+	1	+	+	+	+	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	+	.	+	.	.	+	.	+	.	.	.	.	+
Euclea undulata	+	+	.	.	+	+	1	+	+	.	1	.	.	.	.	.	1	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	+	.
Combretum hereroense	.	+	1	+	3	a	.	+	a	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	1	.	+	.	.	.	.	.
Grewia flava	.	.	+	.	+	.	.	+	+	.	1	+	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	+	.	.	+	.	+	.	+	.	+	.	.	.
Lantana rugosa	.	.	+	.	+	+	.	+	+	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	+	.	.
Hibiscus pusillus	.	.	+	+	.	+	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Felicia mossamedensis	.	.	+	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.
Acacia tortilis	.	.	+	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	.	.	.	+	.
Species group E (Diagnostic species of Sub-community 2.2)																																																
Brachiaria nigropedata	.	.	.	.	.	.	.	.	.	.	+	.	+	+	+	.	1	1	1	.	b	a	1	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Anthephora pubescens	.	.	.	.	.	.	.	.	.	.	.	a	a	+	1	.	.	a	1	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Convolvulus sagittatus	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+	+	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ornithogalum species	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	+	.	+	+	+	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.
Hermannia tomentosa	.	.	.	.	.	.	.	.	.	.	.	.	+	.	1	.	+	.	+	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ledebouria revoluta	.	.	.	.	.	+	.	.	.	.	.	.	+	+	+	.	+	.	+	.	.	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	+
Blepharis subvolubilis	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pseudognaphalum undulatum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.
Limeum viscosum	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+
Ipomoea obscura	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	+	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Chascanum pinnatifidum	.	+	.	.	.	+	.	.	.	.	.	.	+	+	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
Tragia meyeriana	.	+	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Aristida meridionalis	.	.	.	.	.	.	.	.	.	.	.	.	a	.	.	+	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Species group F																																																
Mundulea sericea	+	1	a	+	1	a	.	.	+	+	.	+	.	.	.	+	.	+	+	1	+	+	.	+	.	.	.	+	.	+	.	a	.	.	.	.	.	.	.	+	+	+	.	.	.	.	+	+
Tapinanthus species	+	.	+	.	.	.	+	+	.	.	+	+	+	.	.	.	.	.	+	.	+	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Hermannia stellulata	+	.	+	.	+	.	.	.	.	.	+	.	.	+	.	+	+	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	1	+	.	+	.	.	.	.	.	+	.	.	.	.	.	.
Barleria macrostegia	.	.	+	.	+	.	.	+	+	+	.	.	.	+	.	.	.	+	+	.	+	.	.	.	.	.	.	+	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.

Table 6.1 (continued)

Relevé number			1	1	1	1																																									2	2
	4	4	8	8	8	8	2	2	2	2	5	2	2	2	2	3	4	4	4	4	4	4	5				1	1	1	1	3	3	3	3	4	4	7	7	1	3	3	7	7	3	7	7	1	1
	4	5	2	3	4	5	1	2	7	8	1	3	4	5	6	4	0	1	6	7	8	9	0	7	8	9	0	1	5	6	2	5	8	9	2	3	0	1	2	6	7	6	7	3	2	3	4	5
Community	1						2.1					2.2												3.1															3.2					4				
Species group G (Diagnostic species of Community 3)																																																
Indigofera filipes	.	+	.	.	.	.	.	.	.	.	.	+	+	.	+	1	.	.	.	+	.	.	.	1	.	a	.	+	+	+	.	1	+	+	.	1	+	+	+	+	+	+	.	+	.	.	.	+
Kyphocarpa angustifolia	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+	.	1	.	.	.	.	+	+	+	+	+	+	+	+	1	.	.	+	.	.
Clerodendrum suffruticosum v. *suffruticosum*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	1	+	.	+	.	.	.	1	.	.	1	+	+	.	+	+	+	.	.	.	.	.	.
Combretum molle	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	1	.	.	.	.	.	.	.	+	+	+	+	1	+	b	.	.	.	.	1	+	+	.	a	.	.	.	.	+
Indigofera daleoides	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	+	+	.	+	.	+	.	1	.	.	.	.	+	.	.	1	+	+	+	.	.	+	.	.
Lannea discolor	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	a	.	.	.	.	.	+	+	.	.	.	a	.	b	a	.	+	b	.	.	.	1	.	.	.	.	.	.	.
Nidorella resedifolia s. *resedifolia*	1	+	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	+	.	.	.	.	.	.	.	+	+	.	.	.	+	.	.	.	.	+	+	+	.	+	+	+	.	.	.	.	.	.
Ipomoea coscinosperma	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	+	.	+	.	+	+	.	+	.	.	.	.	.	.
Species group H (Diagnostic species of Sub-community 3.1)																																																
Talinum arnotii	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	+	+	.	+	.	+	+	.	+	.	.	+	.	+	+	.	.	.	.	.	.	.	.	.	+
Combretum zeyheri	.	+	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	1	.	1	.	.	a	b	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Brachiaria deflexa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	+	+	+	+	.	.	.	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.
Oropetium capense	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	+	+	+	+	.	.	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+
Acacia burkei	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	+	.	.	.	.	+	a	.	.	.	+	.	.	.	.	.	.	+	+
Portulaca quadrifida	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	+	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Pellaea calomelanos v. *calomelanos*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	+	.	.	+	.	.	+	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	+
Species group I																																																
Heliotropium steudneri	.	.	+	1	.	.	.	.	.	.	.	a	a	1	b	a	1	+	1	.	b	b	1	1	.	+	.	+	+	.	.	1	a	1	.	.	+	.	+	+	.	.	.	.	.	.	.	.
Kohautia amatymbica	.	.	.	+	.	.	.	.	.	.	.	+	1	1	+	+	+	+	+	1	+	.	+	+	.	.	.	+	+	+	.	1	+	.	+	.	+	+	.	.	+	.	+	.	.	.	.	.
Cleome monophylla	.	.	.	.	.	.	.	+	.	.	.	+	.	.	+	.	+	+	.	.	.	.	.	+	.	+	+	+	+	+	.	.	+	+	.	.	.	+	.	.	.	.	.	+	.	.	.	.
Ceratotheca triloba	+	.	.	.	.	.	+	+	.	.	.	+	+	+	+	+	.	+	.	.	+	+	+	+	+	.	1	+	.	+	+	+	+	+	+	.	+	.	.	+	.	.	.	.	.	.	.	+
Corchorus asplenifolius	.	.	.	+	+	.	.	.	.	.	.	.	+	.	+	.	.	.	.	+	.	.	+	+	.	+	+	.	+	.	.	+	+	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.
Xerophyta retinervis	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	+	1	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	1	+	.	.	.	.	.	.	.	.	.	.	.	.
Sida ovata	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+	.	.	.	.	+	.	.	.	.	.	.	.	.	+	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.

Table 6.1 (continued)																																																
Relevé number			1	1	1	1																																									2	2
	4	4	8	8	8	8	2	2	2	2	5	2	2	2	2	3	4	4	4	4	4	4	5				1	1	1	1	3	3	3	3	4	4	7	7	1	3	3	7	7	3	7	7	1	1
	4	5	2	3	4	5	1	2	7	8	1	3	4	5	6	4	0	1	6	7	8	9	0	7	8	9	0	1	5	6	2	5	8	9	2	3	0	1	2	6	7	6	7	3	2	3	4	5
Community	1						2.1					2.2												3.1															3.2					4				
Species group J																																																
Acacia caffra	.	.	+	+	+	+	b	b	b	b	3	+	a	1	a	1	.	.	.	.	b	1	b	+	.	+	a	.	+	1	+	+	1	b	+	.	+	+	.	.	+	.	+	.	.	.	+	.
Ozoroa paniculosa	+	+	a	a	+	1	.	+	1	.	+	1	a	.	.	a	a	+	.	1	+	1	a	+	+	+	.	+	.	.	+	1	1	1	1	+	+	+	.	.	+	+	.	.	.	.	.	.
Aristida congesta s. *congesta*	.	.	1	a	.	.	.	+	+	+	+	1	+	+	+	+	a	1	1	1	1	.	+	.	+	.	+	.	.	.	+	+	+	+	+	+	+	+	.	.	+	.	+	.	.	.	+	+
Melinis repens	+	1	1	a	a	b	.	.	.	.	+	+	+	+	+	1	1	1	+	+	+	+	.	+	+	.	a	a	.	.	+	+	.	+	+	+	+	.	+	.	.	+	.	.	.	.	.	+
Euphorbia inaequilatera v. *inaequilatera*	.	+	1	+	1	+	.	.	+	+	.	+	+	.	.	1	+	+	+	+	+	+	+	+	+	+	+	+	1	+	+	+	+	.	+	+	+	+	.	+	.	+	.	.	+	.	+	.
Commelina africana	.	.	.	+	.	.	+	.	+	+	.	+	+	+	+	+	+	.	+	+	+	+	+	+	+	.	+	+	.	.	+	+	+	+	+	+	+	+	.	+	.	.	.	.	+	.	+	+
Chamaecrista biensis	.	+	1	1	.	.	+	.	.	.	.	.	+	.	+	1	+	+	+	1	+	.	.	1	+	+	+	.	+	+	.	+	+	+	+	+	.	.	.	.	.	.	+	.	.	.	.	.
Pogonarthria squarrosa	.	.	+	+	.	+	.	.	+	.	+	.	+	+	+	1	.	+	.	+	+	.	.	+	b	+	.	+	+	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Fingerhuthia africana	1	b	.	.	1	a	.	.	+	.	.	.	.	1	1	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	+	.	+	.	.	.	.	1	.	.	.	.	.	.	.	.	1	a
Elephantorrhiza elephantina	+	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	+	.	.	.	+	+	.	+	.	.	.	.	.	+	+	+	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.
Raphionacme velutina	.	+	.	.	.	.	.	+	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Species group K (Diagnostic species of Sub-community 3.2)																																																
Monsonia angustifolia	.	.	.	+	.	.	.	.	.	.	+	.	.	+	.	+	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	+	+	+	1	.	.	.	.	.	.
Grewia flavescens	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	b	a	.	.	.	.	+	.	.
Commiphora pyracanthoides	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.
Striga gesnerioides	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.
Species group L																																																
Tragus berteronianus	.	.	.	.	.	.	+	+	+	.	.	+	+	.	+	.	+	+	.	+	+	.	.	.	.	.	.	.	.	+	+	+	+	.	+	+	.	+	.	.	.	.	+	.	.	.	+	.
Setaria verticillata	.	.	.	.	.	.	+	+	1	+	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	.	.	+	+	.	.	.	.	.	.	.	.	+	+	+	+	a	a	.	.	.	.	.
Species group M																																																
Vitex zeyheri	a	3	b	b	a	a	+	1	.	b	b	1	a	a	a	1	+	1	1	1	1	1	.	+	+	+	.	+	.	.	.	.	1	+	.	.	+	.	.	+	+	+	+	.	.	.	.	.
Heteropogon contortus	+	1	+	.	+	1	.	.	1	1	+	+	1	3	b	+	1	+	b	.	1	+	.	1	1	3	1	a	.	.	b	.	+	.	+	+	+	+	1	1	.	b	a	.	+	.	.	.
Urochloa mosambicensis	+	1	+	1	+	.	+	+	.	+	1	+	+	+	1	+	+	+	+	+	.	.	a	+	.	.	.	.	+	.	.	.	+	.	4	4	.	.	1	b	b	1	.	.	.	.	.	.
Pentarrhinum insipidum	.	.	+	+	+	.	+	1	1	+	+	+	.	.	.	.	+	.	.	+	+	.	+	+	+	+	.	+	+	.	.	+	.	+	.	+	.	+	+	+	+	+	+	.	.	.	.	.
Cucumis zeyheri	+	+	.	+	+	.	+	+	.	.	+	+	+	+	.	+	1	1	+	+	1	+	+	.	.	.	.	.	.	.	.	+	+	.	.	+	+	.	+	.	.	+	+	.	.	.	+	.
Schmidtia pappophoroides	.	.	.	+	.	+	.	+	+	.	.	+	.	+	+	+	+	.	.	+	+	+	+	.	+	+	.	.	.	.	.	+	.	+	+	+	+	.	.	+	+	+	.	.	.	.	.	.
Leucas sexdentata	+	+	+	+	.	.	.	.	.	.	.	+	.	.	.	.	+	1	+	+	.	.	+	1	1	+	.	+	a	a	.	.	.	.	.	.	a	+	1	+	+	.	.	.	+	.	.	.
Sida cordifolia	.	.	a	1	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	+	+	.	.	.	+	+	+	+	.	.	.	+	+	+	.	.	+	+	.	.	+	.	.	.	.	.
Combretum imberbe	.	.	.	1	.	.	1	1	.	.	+	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	.	.	.	.	.	1	+	.	.	a	.	.	.	.	.

Table 6.1 (continued)																																																
Relevé number			1	1	1	1																																									2	2
	4	4	8	8	8	8	2	2	2	2	5	2	2	2	2	3	4	4	4	4	4	4	5				1	1	1	1	3	3	3	3	4	4	7	7	1	3	3	7	7	3	7	7	1	1
	4	5	2	3	4	5	1	2	7	8	1	3	4	5	6	4	0	1	6	7	8	9	0	7	8	9	0	1	5	6	2	5	8	9	2	3	0	1	2	6	7	6	7	3	2	3	4	5
Community	1						2.1					2.2												3.1															3.2					4				
Species group N (Diagnostic species of Community 4)																																																
Kirkia wilmsii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	.	.	b	a	3	b	3
Pappea capensis	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	+	.	a	.	.	+	b	+	1	a	b
Commelina benghalensis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	+	1	1	+
Croton gratissimus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	b	1	+	.
Pouzolzia mixta	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	b	a	1	+
Sphenostylis angustifolia	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	1	1
Crotalaria sphaerocarpa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	a	.	.
Scadoxus puniceus	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	.	+	+	+
Aloe marlothii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	+	1	+	.
Ledebouria ovatifolia	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	+
Berchemia zeyheri	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	a
Sarcostemma viminale	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+	.	.
Species group O																																																
Gymnosporia buxifolia	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	+	.	+	.	+	+	1	.	+	.
Commiphora mollis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	+	+	.	.	+	+	+	.
Panicum maximum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	a	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	a	.	.	.	.
Bridelia mollis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	+	1
Cenchrus ciliaris	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	+	.	.	.	.

Table 6.1 (continued)

Relevé number			1	1	1	1																																									2	2
	4	4	8	8	8	8	2	2	2	2	5	2	2	2	2	3	4	4	4	4	4	4	5				1	1	1	1	3	3	3	3	4	4	7	7	1	3	3	7	7	3	7	7	1	1
	4	5	2	3	4	5	1	2	7	8	1	3	4	5	6	4	0	1	6	7	8	9	0	7	8	9	0	1	5	6	2	5	8	9	2	3	0	1	2	6	7	6	7	3	2	3	4	5
Community	1						2.1					2.2												3.1															3.2					4				
Species group P																																																
Aristida canescens	.	.	.	+	.	.	1	a	a	1	+	+	1	1	+	b	+	+	.	+	+	1	a	b	b	a	a	a	a	b	+	1	a	3	+	+	a	a	3	b	b	1	1	+	1	+	b	a
Acalypha indica	.	.	.	.	.	.	+	+	+	.	.	+	+	+	+	+	.	.	.	.	.	.	.	+	+	+	+	+	+	1	+	+	+	+	.	.	+	+	+	+	.	.	+	.	1	+	1	1
**Achyranthes aspera*	.	.	+	.	.	.	+	+	+	.	+	+	.	.	.	.	.	.	.	.	.	.	+	+	+	a	+	+	a	+	.	.	.	.	+	+	+	a	+	a	+	+	1	+	a	a	+	+
Chrysopogon serrulatus	+	+	.	.	.	.	1	.	.	.	.	+	+	a	1	+	+	+	.	.	.	+	.	.	.	.	+	.	.	.	b	+	.	.	+	+	+	+	.	.	.	.	.	+	1	b	b	b
Sporobolus fimbriatus	.	.	.	.	.	.	+	+	+	.	1	+	.	+	.	.	.	.	.	+	.	.	+	+	.	.	+	.	.	.	.	1	+	+	.	+	+	a	.	.	.	.	.	.	+	+	1	1
Aristida bipartita	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	+	+	+	.
Leucas martinicensis	.	.	.	.	.	.	+	+	+	.	.	+	+	+	.	.	.	.	.	.	+	.	+	.	.	+	.	+	+	.	.	.	+	a	.	.	+	+	+	+	+	+	1	+	+	+	.	+
Pavonia burchellii	.	.	.	.	.	.	.	+	+	+	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	.	.	+	+	+	.	.	.	+	.	.	.	+
Grewia monticola	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	1	.	+	.	.	.	.	.	.	.	.	+	.	.	.	1	+	.	.	.	+
Species group Q																																																
**Schkuhria pinnata*	+	+	+	+	.	.	a	a	b	a	1	1	1	+	+	+	1	+	1	+	1	a	1	+	+	a	1	a	3	b	+	+	3	b	1	.	b	1	1	+	+	+	.	+	+	.	+	+
Eragrostis rigidior	+	+	3	b	1	+	+	+	+	.	+	b	+	+	+	.	.	+	+	+	+	b	3	+	a	+	a	.	+	+	+	a	+	+	+	+	1	1	a	.	+	3	1	.	+	.	1	+
Solanum panduriforme	.	+	+	+	.	.	b	b	+	+	+	1	+	.	+	a	+	+	+	.	+	+	+	1	a	+	a	a	+	+	.	+	1	+	+	+	1	+	a	+	1	+	+	+	.	.	+	+
**Zinnia peruviana*	1	+	1	1	+	+	+	+	+	.	1	+	+	.	+	.	.	.	+	+	+	+	a	+	+	1	1	a	+	+	.	.	+	+	1	+	1	a	a	1	+	.	+	+	+	+	a	1
Dichrostachys cinerea	b	b	+	+	+	+	.	.	.	.	+	.	.	.	+	.	1	1	1	1	+	+	+	+	1	a	+	+	b	a	.	.	a	a	a	a	b	+	3	a	b	b	3	.	+	+	1	1
Digitaria eriantha	.	.	+	+	1	+	a	3	b	b	b	1	1	+	+	a	1	1	3	a	+	+	1	.	.	1	+	.	.	.	+	+	1	+	+	.	+	+	.	.	+	.	a	+	+	1	+	1
Sclerocarya birrea	+	+	+	1	.	.	.	.	+	.	.	+	a	.	.	.	+	+	+	.	.	.	+	1	b	a	a	a	+	+	+	a	a	+	+	+	+	+	1	a	.	+	+	+	1	+	.	+
**Bidens bipinnata*	.	.	+	+	.	+	+	+	+	+	+	+	.	+	.	.	.	.	.	+	.	.	+	+	+	+	+	+	+	+	.	+	1	+	+	+	+	+	+	1	+	+	+	.	+	+	1	1
**Tagetes minuta*	+	1	.	.	.	.	.	+	.	+	1	.	.	+	+	.	a	+	+	a	+	1	b	+	.	.	.	+	+	.	+	.	+	a	+	1	+	+	.	3	1	b	1	a	1	1	+	+
Waltheria indica	1	+	+	1	+	.	.	+	.	.	.	+	+	.	.	.	+	+	+	1	.	.	+	+	.	1	+	1	+	+	+	.	+	+	+	+	.	.	+	+	+	+	+	.	.	.	+	+
Combretum apiculatum	.	+	+	+	a	+	.	.	.	.	+	.	.	.	.	1	.	.	+	.	.	.	+	3	b	a	3	b	b	b	a	+	.	.	1	+	1	a	b	b	+	a	1	+	.	.	+	a
Dombeya rotundifolia	.	+	+	+	+	+	a	b	b	1	+	1	.	.	+	.	.	.	.	a	+	.	a	+	.	.	.	.	+	a	.	.	+	+	+	1	.	1	+	+	a	+	1	+	.	.	1	+
Bulbostylis humilis	+	+	.	.	1	1	.	.	.	.	.	1	+	.	+	+	.	.	.	+	+	+	+	+	a	+	+	+	+	+	1	+	a	+	+	+	.	+	.	+	.	.	.	1	+	1	+	+
Enneapogon cenchroides	a	1	.	+	+	+	+	1	.	+	+	+	.	.	.	1	.	.	+	.	+	.	+	1	+	1	+	+	1	+	+	.	.	.	+	+	.	.	.	+	+	.	.	+	+	.	+	.
Tephrosia purpurea	+	a	a	a	a	a	.	.	.	.	.	.	.	1	+	+	.	.	+	.	.	.	+	+	+	+	.	b	1	+	+	.	.	+	+	.	+	+	+	1	1	+	1	+	.	.	+	+
Aristida diffusa	+	+	.	.	+	.	.	.	+	+	.	+	+	+	+	.	+	.	+	.	+	+	+	+	+	+	+	.	.	+	1	+	1	+	.	.	.	.	+	.	1	.	.	1	.	.	.	+
Rhynchosia totta	+	+	.	.	+	+	.	.	+	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	+	.	+	.	+	+	+	+	.	.	+	.	.	.	+	.	.	.	+	.	+	.	.
Rhynchosia minima	.	+	.	.	a	a	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	b	.	.	.	.	.	.	1	.	1	+	.	1	1	+	+	+	a
Enneapogon scoparius	.	.	.	.	+	+	.	+	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	1	.	.	1	.	.	.	+	.	.	+	+	.	.	.	+	3	a	b	.	.

* Alien species

6.3 Description of plant communities

All the species and species groups that will be referred to are included in Table 6.1. The values given for anthropogenic influences, such as bush thickening and disturbance are averages for the community or sub-community being discussed. This is also the case in description of the physiognomy of each community. Some species were only recorded once or a few times with a low cover abundance or they were not confined to a specific species group. These species were not included in Table 6.1, but they are given in Table 6.5 at the end of this Chapter.

1. *Lippia javanica* - *Vitex zeyheri* Community

The *Lippia javanica* - *Vitex zeyheri* Community (Figure 6.2) was found on calcareous sandy loam soil with a calcium content of 4 708 mg/kg. It had a low concentration of potassium (92 mg/kg) and a high pH (7.9). The soil in this community was the deepest (average 87 cm) of all the communities in the Fa land type and it also had a higher clay percentage (although it was still low compared to the Ae and Ea land types). In this community there were also more rocks on the soil surface than in Community 2. This community was encountered on the farms Bloemendal and Renosterkop in the north-eastern part of the study area on foot- and midslopes. Soil forms found in this community are Brandvlei, Mispah and Glenrosa. Particle distribution for particles smaller than 2 mm was: sand = 72.4 %, silt = 19.4 % and clay = 8.1 %. Particles larger than 2 mm made up 23.5 % of the soil. The area was used for cattle grazing. Moderate levels of overgrazing, sheet erosion and compaction were encountered in this community and bush thickening was 38 %.

The diagnostic species for this community can be found in species group A and include the shrub *Lippia javanica*, the perennial herb *Aptosimum lineare* and the tree *Acacia nilotica*. This community was further characterised by the absence of species group P. Dominant species included the tree *Vitex zeyheri* (Species group M), the annual herb *Tephrosia purpurea* (Species group Q), the annual grass *Melinis repens* (Species group J) and the perennial grass *Eragrostis rigidior* (Species group Q). An average of 57 species was recorded per relevé and 4.8 % of the species were aliens. Two protected trees according to the Department of Water Affairs and Forestry (2007) were found in this community: *Sclerocarya birrea* was found in most of the relevés of this community and *Combretum imberbe* was found a few times.

The grass and tree strata both had a cover of 38 %, the forb stratum had a cover of 32 % and the shrub stratum had a cover of 16 %. The tree stratum was 3.2 m tall, which was considerably lower than the other communities. The shrub stratum had a height of 1.3 m and the grass and forb strata both had a height of 0.3 m.

Figure 6.2 *The Lippia javanica - Vitex zeyheri* Community (Community 1) of the Fa land type. GPS reading: lat 24°49'22.9"S, long 26°57'33.6"E. Unlike the Ae and Ea land types, the Fa land type was not dominated by *Acacia* species, but rather by a variety of macrophyllous trees.

2. *Tarchonanthus camphoratus - Acacia caffra* Community

This community was found on shallow, sandy loam soil with fewer rocks on the soil surface (14 %), than most of the other communities in the Fa land type. It was encountered on the farms Bedford, Hanover and Boschkop on gentle south facing midslopes, in the southern part of the Fa land type. The most common soil forms were Glenrosa, Hutton and Mispah. The Dresden soil form and some other soil forms were also encountered. Particle distribution for particles smaller than 2 mm was: sand = 76 %, silt = 18.1 % and clay = 5.9 %. Particles larger than 2 mm made up 15.4 % of the soil. The soil pH was 6.6 and average soil depth was 40 cm. Moderate levels of sheet erosion and overgrazing were noted, and some compaction, while bush thickening was 12 %.

The diagnostic species included the tree *Tarchonanthus camphoratus*, the perennial grasses *Eragrostis superba* and *Eustachys paspaloides* and the perennial herb *Chascanum hederaceum* (species group B). This community was further characterised by the absence of species groups A, G and N. The dominant species were the trees *Acacia caffra* (species group J) and *Vitex zeyheri* (species group M), the perennial grasses *Digitaria eriantha* (species group Q) and *Aristida canescens* (species group P) and the alien annual herb *Schkuhria pinnata* (species group Q). An average of 57 species was recorded per relevé and 3.6 % of all the species recorded in this community were aliens. The protected trees *Sclerocarya birrea* and *Combretum imberbe* (Department of Water Affairs and Forestry, 2007) were both found a few times in this community.

The grass stratum was well developed, with a cover of 48 % and a height of 0.3 m. The tree stratum had a cover of 31 % and it was 4.6 m high (Figure 6.3). The forb stratum had a cover of 33 % and it was 0.4 m high and the shrub stratum had a cover of 16 % and a height of 1.1 m.

Figure 6.3 The *Tarchonanthus camphoratus* - *Acacia caffra* Community (Community 2) of the Fa land type. GPS reading: lat 24°54'09.5"S, long 26°52'54.9"E.

A somewhat similar vegetation unit was identified by Zacharias (1994), namely the *Combretum apiculatum* with *Vitex* and *Tarchonanthus* vegetation unit.

The *Tarchonanthus camphoratus* - *Acacia caffra* Community could be divided into two sub-communities.

2.1 *Acacia karroo* - *Acacia caffra* Sub-community

The *Acacia karroo* - *Acacia caffra* Sub-community was found on sandy loam soil. This sub-community could be identified on the aerial photographs as darker strips in the Fa land type, running perpendicular to the contour lines (Figure 6.4). It was found on midslopes. The soil of Sub-community 2.1, with an average depth of 56 cm, was deeper than those of Sub-community 2.2. The Glenrosa, Hutton and Shortlands soil forms were encountered in this sub-community. Particle distribution for particles smaller than 2 mm was: sand = 71.8 %, silt = 20.7 % and clay = 7.5 %. Particles larger than 2 mm made up 15.2 % of the soil. Low levels of sheet erosion were noted in this sub-community. There was more compaction, but less sheet erosion in Sub-community 2.1 than in Sub-community 2.2 and bush thickening was 19 %.

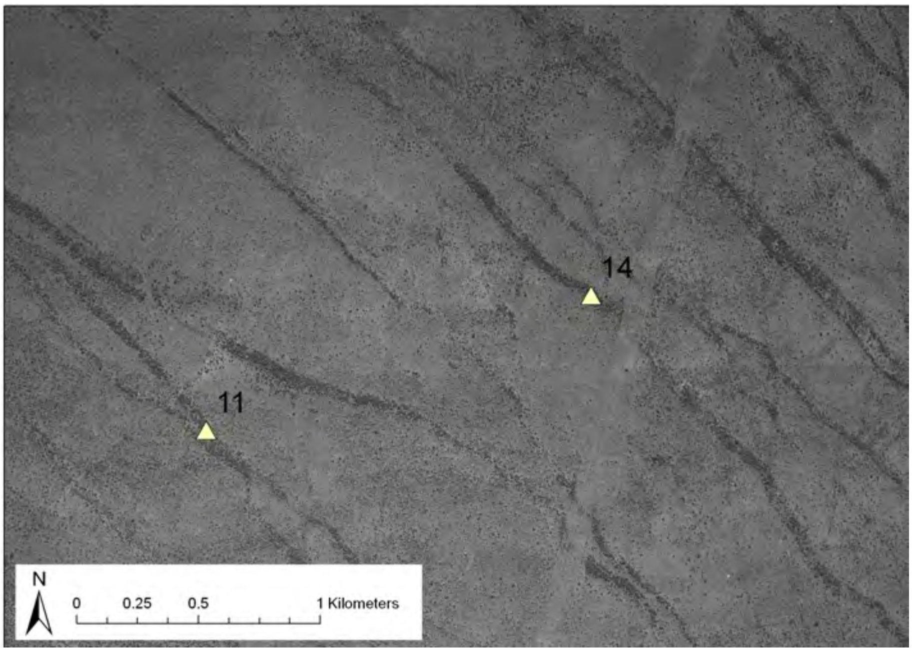

Figure 6.4 The *Acacia karroo* - *Acacia caffra* Sub-community can be seen on this aerial photograph as darker strips. These strips appear darker because of the dense tree layer. Sites 11 and 14, which was carried out in two of these strips are indicated with triangles. The lighter strip to the right of site 14 is a power line, beneath which the trees were removed.

The diagnostic species included the tree *Acacia karroo* the perennial herb *Withania somnifera* and the annual herb *Sida spinosa* (species group C). The dominant species were the tree *Acacia caffra* (species group J), the perennial grass *Digitaria eriantha* (species group Q), the annual alien herb *Schkuhria pinnata* (species group Q) and the tree *Dombeya rotundifolia* (species group Q). An average of 55 species was recorded per relevé (which is three lower than in Sub-community 2.2) and 5.6 % of the species were aliens. The red data species *Hypoxis hemerocallidea,* that falls into the 'Declining' category (South African National Biodiversity Institute, 2009) was found in this sub-community.

The percentage cover of al the strata in Sub-community 2.1 were higher than those of Sub-community 2.2. This is why it formed darker strips on the aerial photographs indicating denser vegetation. The cover was 51 % for the grass stratum, 45 % for the tree stratum, 36 % for the forb stratum and 20 % for the shrub stratum. The height of the tree stratum was 5 m and it was 0.5 m for the forb stratum. Both were higher than those of Sub-community 2.2. The height of the other strata was the same for the two sub-communities.

2.2 *Brachiaria nigropedata - Digitaria eriantha* Sub-community

The *Brachiaria nigropedata* - *Digitaria eriantha* Sub-community was found on sandy soil, on midslopes. The soil of Sub-community 2.2 had a high concentration of sodium (45 mg/kg). It was shallower (34 cm) and more sandy than those of Sub-community 2.1. Particle distribution for particles smaller than 2 mm was: sand = 80.3 %, silt = 15.5 % and clay = 4.3 %. Particles larger than 2 mm made up 15.7 % of the soil. The most common soil forms were Glenrosa, Mispah and Dresden but the Hutton and Bainsvlei soil forms were also found. Bush thickening was 9 %.

The diagnostic species for the *Brachiaria nigropedata - Digitaria eriantha* Sub-community were the perennial grasses *Brachiaria nigropedata* and *Anthephora pubescens*, the perennial herbs *Convolvulus sagittatus* and *Hermannia tomentosa* and the geophyte *Ornithogalum* species (species group E). The dominant species included the perennial herb *Heliotropium steudneri* (species group I), the trees *Vitex zeyheri* (species group M) and *Ozoroa paniculosa* (species group J) and the perennial grasses *Digitaria eriantha* (species group Q) and *Brachiaria nigropedata* (species group E). An average of 58 species was recorded per relevé and 3.5 % of all the species recorded were aliens.

The cover of the grass stratum was 46 %. It was 17 % for the tree stratum, 30 % for the forb stratum and 11 % for the shrub stratum. The tree stratum was 4.1 m high and the forb stratum was 0.3 m high.

3. *Indigofera filipes - Combretum apiculatum* Community

This community was found on shallow sandy soil on gentle north facing foot- and midslopes (Figure 6.5). The soil was deeper than those of Communities 2 and 4, but shallower than that of Community 1, with an average soil depth of 40 cm. Particle distribution for particles smaller than 2 mm was: sand = 80.6 %, silt = 14.2 % and clay = 5.2 %. Particles larger than 2 mm made up 5.4 % of the soil. Soil had a low potassium concentration (87 mg/kg) and a pH of 6.52. The *Indigofera filipes - Combretum apiculatum* Community was spread out over a larger area than the other communities. It was found on the farms Spitskop, Tusschenkomst, Goedehoop, Gansvley, Roodebloem, Goedgedacht, Distriktshoek and Bloemendal, in the northern part of the study area. The most common soil forms found in this community were the Mispah and Glenrosa soil forms. The Hutton and Bainsvlei soil forms were also encountered. Little overgrazing and compaction were visible in this community, moderate levels of sheet erosion were encountered and bush thickening was 33 %.

The species in species group G are the diagnostic species for the *Indigofera filipes - Combretum apiculatum* Community. They included the perennial herb *Indigofera filipes*, the annual herb *Kyphocarpa angustifolia*, the perennial dwarf shrub *Clerodendrum suffruticosum* var. *suffruticosum* and the trees *Combretum molle* and *Lannea discolor*. This community was further characterised by the absence of species groups F and N. The dominant species were the perennial grass *Aristida canescens* (species group P), the trees *Combretum apiculatum* and *Dichrostachys cinerea* and the annual alien herb *Schkuhria pinnata* (species group Q). An average of 55 species was recorded per relevé and 4 % of the species were aliens. The protected tree *Sclerocarya birrea* (Department of Water Affairs and Forestry, 2007) was found in all the relevés of this community. Another protected tree, *Combretum imberbe,* was found a few times in this community.

Figure 6.5 The *Indigofera filipes* - *Combretum apiculatum* Community (Community 3) of the Fa land type. GPS reading: lat 24°52'19.6"S, long 26°39'36.5"E.

The grass stratum was well developed in this community, with a cover of 46 % and a height of 0.4 m. The tree, forb and shrub strata had covers of 44 %, 36 % and 16 % and heights of 4.9 m, 0.4 m and 1.1 m respectively.

A somewhat similar community, the *Combretum apiculatum* – *Aristida barbicollis* (*Aristida congesta* subsp. *barbicollis*) Community, was described by Morris (1972). It was found on Mispah soil and the dominant species were similar. The diagnostic species, however, were different.

The *Indigofera filipes* - *Combretum apiculatum* Community could be divided into two sub-communities.

3.1 *Clerodendrum suffruticosum* var. *suffruticosum* - *Sclerocarya birrea* Sub-community

The *Clerodendrum suffruticosum* var. *suffruticosum* - *Sclerocarya birrea* Sub-community was found on sandy soil on midslopes. There was a clear difference between the environmental variables of the two sub-communities. Sub-community 3.1 was found on more sandy and shallower soil (26 cm) than Sub-community 3.2. Sub-community 3.1 had more rocks on the soil surface and was found on steeper slopes (10°, Sub-community 3.2 had an average slope of 2°). Particle distribution for particles smaller than 2 mm was: sand = 83.1 %, silt = 13 % and clay = 3.9 %. Particles larger than 2 mm made up 7.7 % of the soil. The dominant soil forms in this sub-community were Glenrosa and Mispah. The Hutton and Bainsvlei soil forms were also found less frequently. Less overgrazing and bush thickening (22 %) were noted in this sub-community than in Sub-community 3.2.

The diagnostic species for this sub-community included the tree *Combretum zeyheri*, the annual dwarf shrub *Talinum arnotii,* the annual and perennial grasses *Brachiaria deflexa* and *Oropetium capense* respectively and the tree *Acacia burkei* (species group H). The same species that were dominant in Community 3 were also dominant in the two sub-communities. An average of 53 species per relevé was recorded and 4.3 % of the recorded species were aliens.

The grass stratum was well developed with a cover of 46 % and a height of 0.4 m. The tree stratum had a cover of 34 % and a height of 4.7 m. The forb and shrub strata had covers of 37 % and 9 % and heights of 0.4 m and 1.1 m respectively. The cover of both the tree and shrub strata was lower in Sub-community 3.1 than in Sub-community 3.2.

3.2 *Monsonia angustifolia* - *Dichrostachys cinerea* Sub-community

The *Monsonia angustifolia - Dichrostachys cinerea* Sub-community was found on sandy loam soil that were deeper than those of Sub-community 3.1. The average soil depth was 84 cm, which is 58 cm deeper than the soil of Sub-community 3.2. This community was found on footslopes closer to the northern border of the Fa land type. The soil also had a high sodium concentration (51 mg/kg). Particle distribution for particles smaller than 2 mm was: sand = 78.1 %, silt = 15.4 % and clay = 6.5 %. Particles larger than 2 mm made up 3.1 % of the soil. The following soil forms were found in this sub-community: Hutton, Shortlands, Bainsvlei and Mispah. There were more disturbances in Sub-community 3.2 than in Sub-community 3.1. There was moderate overgrazing and bush thickening was 68 %, which was the highest of all the communities and sub-communities of the Fa land type.

The diagnostic species for this sub-community can be found in species group K and include the annual herb *Monsonia angustifolia*, the shrub *Grewia flavescens* and the tree *Commiphora pyracanthoides.* An average of 58 species per relevé was recorded and 4.4 % of all the recorded species were aliens.

Due to bush thickening, the tree stratum formed the dominant stratum in the *Monsonia angustifolia - Dichrostachys cinerea* Sub-community, with a cover of 55 % and a height of 5 m. The grass stratum had a cover of 45 % and a height of 0.4 m. The forb stratum had a cover of 35 % and it was 0.4 m in height and the shrub stratum had a cover of 24 % and it was 1.2 m tall.

4. *Pappea capensis - Kirkia wilmsii* Community

The *Pappea capensis - Kirkia wilmsii* Community was found on calcareous sandy loam soil, on rocky hills in the otherwise relatively even Fa land type (Figure 6.6). The soil was high in calcium (4 983 mg/kg), magnesium (1 143 mg/kg), potassium (218 mg/kg) and phosphorus (9.6 mg/kg), which resulted in high base saturation and pH (7.56). The electrical conductivity of this community was the highest of all the communities and there was also the highest percentage of particles larger than 2 mm according to the particle size distribution analysis (see Figure 6.9). Particles larger than 2 mm made up 43.7 % of the soil. Particle distribution for particles smaller than 2 mm was: sand = 66.4 %, silt = 26.8 % and clay = 6.8 %. The soil was sandy and shallow (average 8 cm deep) and the slope was considerably steeper than in the other communities. Four of the five relevés were located on the Mispah soil form and the other relevé on the Glenrosa soil form. Only five relevés were completed in this community, as there were only a few of these hills in the study area. Site 17 was done from the bottom to the top of a hill; with relevé 32 at the bottom and 33 at the top. This caused relevé 32 to fall into Community 3, while relevé 33 fell into Community 4. This explains why there is an uneven number of relevés sampled in this community. It is not ideal as the relevés should have fallen into the same homogenous unit. It is however the result of working in an interdisciplinary team where transects were done parallel to the slope. The sampled rocky hills were located on the farms De Paarl, Goedgedacht and Roodebloem. There was very little disturbance, only low levels of sheet erosion, very little overgrazing and bush thickening was only 10 %.

The diagnostic species for this community are found in species group N. These species included the trees *Kirkia wilmsii*, *Pappea capensis*, *Croton gratissimus* and *Pouzolzia mixta* and the annual herb *Commelina benghalensis*. This community was further characterised by the absence of species group M. The dominant species were the trees *Kirkia wilmsii* and *Pappea capensis* (species group N) and the perennial grasses *Chrysopogon serrulatus* and *Aristida canescens* (species group P). An average of 52 species was recorded per relevé, which is somewhat lower than the species diversity of the other communities in the Fa land type. Of all the recorded species, 5.4 % were aliens. Two protected tree species were found in this community: *Sclerocarya birrea* was found in most of the relevés and *Erythrophysa transvaalensis* (Department of Water Affairs and Forestry, 2007) was found once.

Figure 6.6 The *Pappea capensis - Kirkia wilmsii* Community (Community 4) of the Fa land type. GPS reading: lat 24°53'31.6"S, long 26°45'54.5"E. Community 4 was found on rocky hills, as can be seen in this photograph.

The well developed tree stratum was 5.3 m tall and had a cover of 42 %. The grass, forb and shrub strata had covers of 36 %, 35 % and 24 % and heights of 0.5 m, 0.6 m and 1.4 m respectively. All the strata were higher-growing than in all the other communities, probably due to less burning and grazing in these rocky inaccessible areas.

6.4 Ordinations

Correspondence Analysis (CA) and Principal Component Analysis (PCA) ordinations were carried out to determine the correlations between the species data and the environmental data of the sample plots in the different plant communities, by investigating the correlation coefficients between the environmental factors and the two ordination axes. A CA ordination was carried out including all four communities of the Fa land type (Figure 6.7). Steep slopes and percentage rocks on the soil surface formed a strong correlation with the first ordination axis with correlation coefficients of 0.87 and 0.76 respectively (Table 6.2). Community 4 was found on hills and one would expect it to be very different from the other communities in both species composition and environmental variables. Soil depth had a negative correlation coefficient of -0.29 with ordination axis one, indicating that Community 4 was also found on shallower soil than the other communities of the Fa land type.

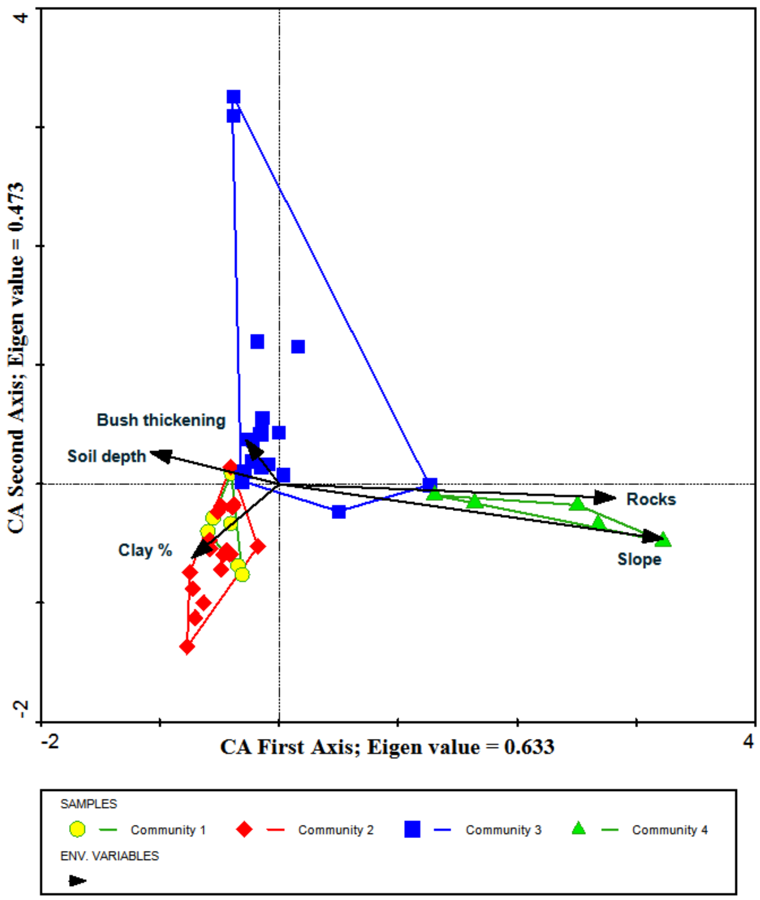

Figure 6.7 CA biplot of Communities 1 to 4 of the Fa land type: the *Lippia javanica* - *Vitex zeyheri* Community (1), the *Tarchonanthus camphoratus* - *Acacia caffra* Community (2), the *Indigofera filipes* - *Combretum apiculatum* Community (3) and the *Pappea capensis* - *Kirkia wilmsii* Community (4), showing environmental variables and samples/relevés.

Table 6.2 Correlation coefficients of environmental factors of Figure 6.7.

Environmental Factor	Ordination Axis 1	Ordination Axis 2
Clay %	-0.1977	-0.1802
Soil depth	-0.2923	0.0783
Bush thickening	-0.0760	0.1071
Slope	0.8717	-0.1335
Rocks	0.7625	-0.0344

Another CA ordination was carried out including only Communities 1 to 3 (Figure 6.8), to illustrate the differences between these three communities in terms of species composition and how environmental variables are correlated with species composition. Both slope and percentage rocks on the soil surface correlated strongly with the second ordination axis with correlation coefficients of 0.56 and 0.54 respectively (Table 6.3). These two environmental variables varied within Community 3 but in general, the slope and percentage rocks on the soil surface were higher in Community 3 than in Communities 1 and 2. Percentage clay in the soil was not considered, as no correlations were formed with any of the three communities.

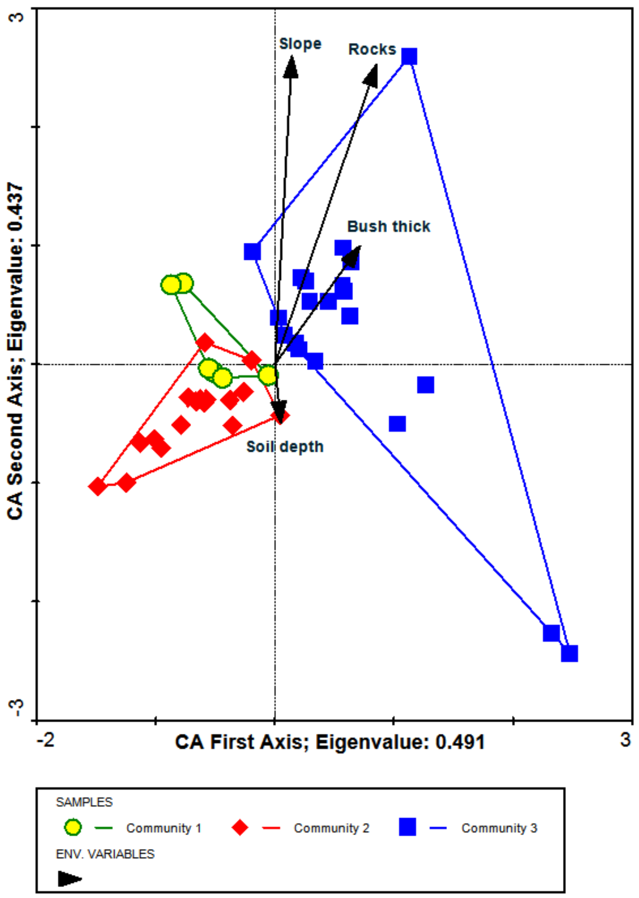

Figure 6.8 CA biplot of Communities 1 to 3 of the Fa land type: the *Lippia javanica* - *Vitex zeyheri* Community (1), the *Tarchonanthus camphoratus* - *Acacia caffra* Community (2) and the *Indigofera filipes* - *Combretum apiculatum* Community (3), showing environmental variables and samples/relevés.

Table 6.3 Correlation coefficients of the environmental factors of Figure 6.8.

Environmental Factor	Ordination Axis 1	Ordination Axis 2
Soil depth	0.0099	-0.1066
Bush thickening	0.1491	0.2132
Slope	0.0298	0.5564
Rocks	0.1778	0.5409

Another CA biplot was carried out to determine differences in environmental factors between Communities 1 and 2 (Figure 6.9). Slope, bush thickening and percentage rocks on the soil surface had a strong correlation with ordination axis 1 with correlation coefficients of 0.80, 0.61 and 0.57 respectively (Table 6.4). This indicates that Community 1 was found on steeper slopes with a higher percentage rocks on the soil surface than Community 2. Bush thickening was also higher in Community 1 than in Community 2. Community 1 was further found on deeper soil than Community 2, as soil depth had a correlation coefficient of 0.46 with the first ordination axis. Although Sub-communities 2.1 and 2.2 did not show any clear differences in terms of the environmental variables indicated in Figure 6.9, the averages for this community indicate that they differ with respect to soil depth and clay percentage.

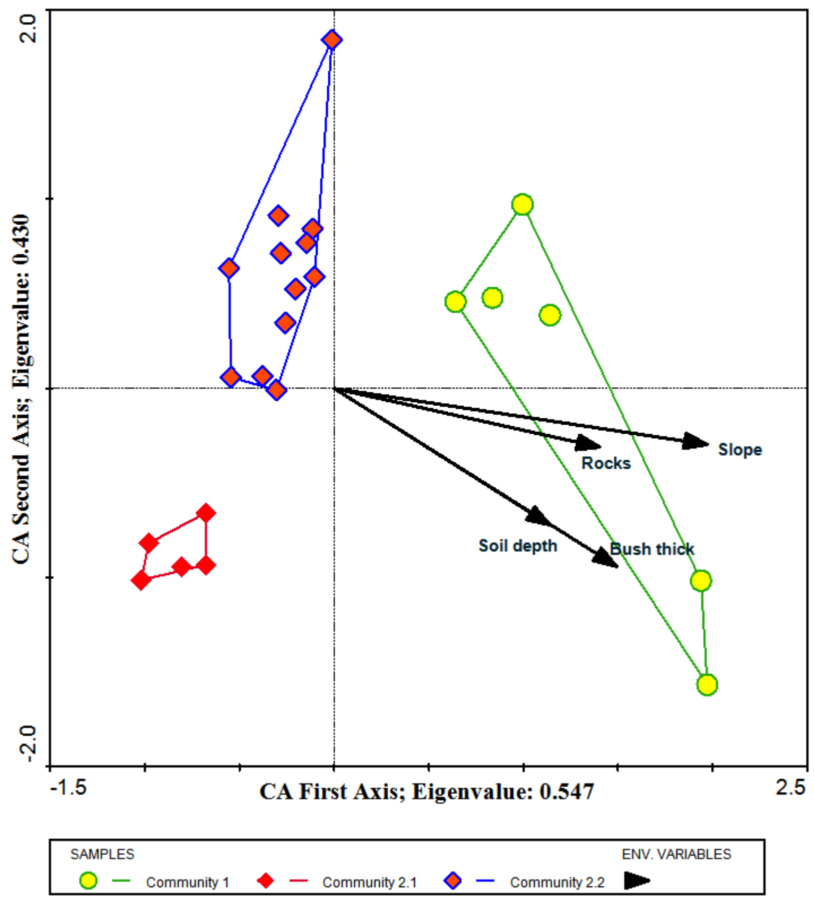

Figure 6.9 CA ordination biplot showing environmental variables and samples/relevés of Communities 1 and 2 of the Fa land type: the *Lippia javanica* - *Vitex zeyheri* Community (1), the *Tarchonanthus camphoratus* - *Acacia caffra* Community (2): the *Acacia karroo* - *Acacia caffra* Sub-community (2.1) and the *Brachiaria nigropedata* - *Digitaria eriantha* Sub-community (2.2).

Table 6.4 Correlation coefficients of environmental factors of Figure 6.9.

Environmental Factor	Ordination Axis 1	Ordination Axis 2
Soil depth	0.4622	-0.3118
Bush thickening	0.6054	-0.4052
Slope	0.8000	-0.1274
Rocks	0.5696	-0.1340

Differences between the environmental variables of Sub-communities 3.1 and 3.2 could be determined by looking at the averages for the two sub-communities. The soil of Sub-community 3.2 was deeper and the percentage rocks on the soil surface was lower than in Sub-community 3.1. Bush thickening was considerably higher in Sub-community 3.2 than in Sub-community 3.1.

A PCA ordination was carried out with the data from the soil analyses (Figure 6.10). This ordination shows that Communities 1 and 4 were found on calcareous soil, with high contents of potassium (K), phosphorus (P) and magnesium (Mg) in community 4 (Figure 6.10). The pH was the highest in Communities 1 and 4, due to the high concentrations of cations. The base saturation for both Communities 1 and 4 was high with 112 % and 116 % respectively. The electrical conductivity (EC) was the highest in Community 4 (177 mS/m) and the soil particle size above 2 mm also had the highest percentage in this community. The soil of Communities 2 and 3 were sandier, with a high concentration of sodium (Na). The soil of Community 1 on the other hand were more clayey (Figure 6.10). The average potassium (P) concentration for Communities 1 and 3 was also lower than that of the other communities, at 92 mg/kg and 78 mg/kg respectively.

6.5 Map units, soil and distribution of relevé pairs

Community 1 was located in the eastern part of the Fa land type and Community 2 in the southern part. The Fa land type does not have a steep slope, but from the map it is clear that Community 2 was found on a gentle south facing slope.

According to the aerial photographs, Sub-community 2.1 appears as darker strips, running perpendicular to the contour lines. This can be attributed to the fact that Sub-community 2.1 occurs in deeper soil with denser vegetation and more trees than Sub-community 2.2. These lines were on both south and north facing slopes, but only the lines on south facing slopes were surveyed. The species composition may differ on the northern slopes.

Sixteen of the 48 relevés were found on the Mispah soil form and 15 on the Glenrosa soil form. Ten relevés were found on soil with red apedal B-horizons. No vertic soil was found in this land type. The average clay percentage for the Fa land type was 15 %, which is considerably lower than the clay percentage of the Ae and Ea land types. This correlates with the description of the soil by Land Type Survey Staff (1988) and Mucina & Rutherford (2006).

As mentioned in Chapter 3, two relevés were completed at each site. Some of these relevé pairs in the Fa land type did not fall into the same community. This was a problem at sites 6, 17, 18 and 26. At site 6 bush thinning has been done in the first relevé but not in the second. There was also a higher percentage rocks on the soil surface, which caused it to better fit in with Sub-community 3.1, while the second relevé fell into Sub-community 3.2. The soil forms found at the two relevé of site 18 were different, which explain the differences in species composition and why they fell into different communities. There were more disturbances at the first relevé of site 26 than in the second relevé. The difference between the two relevés of site17 was not clear. The relevé pairs should have fallen into the same homogenous unit and this method was therefore not very successful, it was however done to accommodate the carrying capacity and small mammal studies.

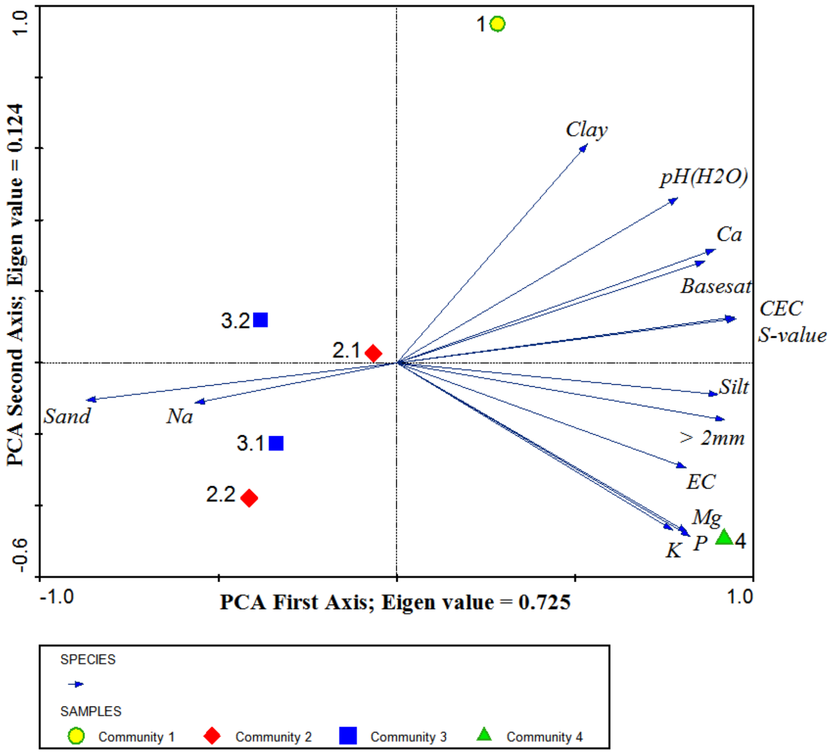

Figure 6.10 PCA ordination biplot of the soil data from the different communities and sub-communities of the Fa land type. The following communities are shown on the graph: the *Lippia javanica* - *Vitex zeyheri* Community (1), the *Tarchonanthus camphoratus* - *Acacia caffra* Community (2): the *Acacia karroo* - *Acacia caffra* Sub-community (2.1), the *Brachiaria nigropedata* - *Digitaria eriantha* Sub-community (2.2), the *Indigofera filipes* - *Combretum apiculatum* Community (3): the *Clerodendrum suffruticosum* var. *suffruticosum* - *Sclerocarya birrea* Sub-community (3.1), the *Monsonia angustifolia* - *Dichrostachys cinerea* Sub-community (3.2) and the *Pappea capensis* - *Kirkia wilmsii* Community (4).

6.6 Species composition

Of all the recorded species in the Fa land type, 96 % were indigenous and 75 % perennial. Only two of the fourteen alien species found in this land type were perennial, the rest were annual and therefore they did not pose a serious threat to indigenous vegetation. The most common growth form was herbs and then shrubs (Figure 6.11). The average species richness was 43 species per relevé.

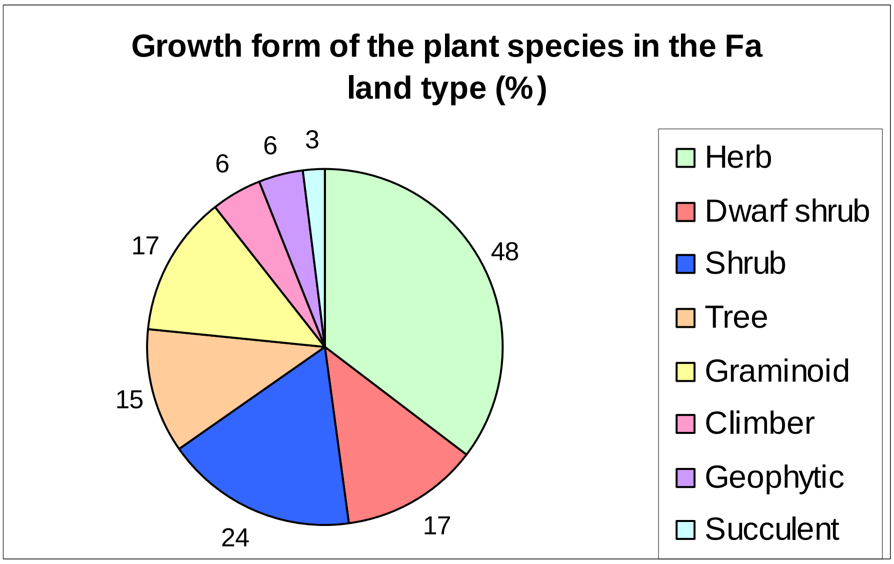

Figure 6.11 Composition of the different growth forms of the species in the Fa land type. Almost half of the species (48 %) were herbs and 24 % were shrubs.

6.7 Conclusion

The Fa land type in the Central Corridor Area (CCA) fell into the Madikwe Dolomite Bushveld vegetation type (Mucina & Rutherford, 2006), which is characterized by broad-leaved tree species and is found on shallow, sandy soil. Four communities and four sub-communities were identified and described in the Fa land type in the CCA. From the ordinations and the averages of the environmental data it could be concluded that, unlike in the Ae and Ea land types, clay percentage and soil depth did not have such a great influence on the distribution and species composition of the communities. In the Fa land type it is rather slope, aspect and percentage rocks on the soil surface. The *Pappea capensis* - *Kirkia wilmsii* Community (Community 4) was found on hills, therefore it was correlated with a steep slope and a high percentage rocks on the soil surface. The *Lippia javanica* - *Vitex zeyheri* Community (Community 1) was generally located on eastern slopes, the *Tarchonanthus camphoratus* - *Acacia caffra* Community (Community 2) on southern slopes and the *Indigofera filipes* - *Combretum apiculatum* Community (Community 3) on northern slopes. Community 3 was found on steeper slopes and had a higher percentage rocks on the soil surface and bush thickening than Communities 1 and 2. Community 1 was further found on steeper slopes with a higher percentage rocks on the soil surface than Community 2. Three protected tree species, namely *Sclerocarya birrea*, *Combretum imberbe* and *Erytrophysa transvaalensis* and one red data species: *Hypoxis hemerocallidea* were recorded in this land type. A community that was similar to Community 2 was identified and described by Zacharias (1994) in the Madikwe Game Reserve. A community that was somewhat similar to Community 3 was identified and described by Morris (1972) in the Thabazimbi district.

Table 6.5 List of species for the Fa land type which is not shown in Table 6.1, because they occurred only once or a few times with a low cover abundance or they were not confined to specific communities.

Community	**Species (relevé number)(cover abundance value)**
1.	*Acacia mellifera* (185)(+); *Aloe greatheadii* (185)(+); *Aptosimum procumbens* (182)(+); *Barleria pretoriensis* (185)(+); *Dicerocaryum eriocarpum* (182)(+); *Dichapetalum macrocarpum* (185)(+); **Gomphrena celosioides* (182)(+); *Menodora heterophylla* (45)(+); *Oxygonum delagoense* (183)(+); *Phyllanthus luandensis* (184)(+); *Polygala hottentotta* (184)(+); *Portulaca kermesina* (184)(+); *Psiadia punctulata* (45)(+), (185)(1); *Rhus lancea* (45)(+)
2.	*Aristida stipitata* (22)(+), (24)(+), (49)(+); *Brachiaria serrata* (24)(+), (25)(+), (28)(+), (41)(+); *Datura ferox* (22)(+), (50)(+); *Eleusine coracana* subsp. *coracana* (22)(+), (24)(+); *Eriospermum flagelliforme* (25)(+), (27)(+); *Hermannia depressa* (27)(+), (28)(1), (44)(+); *Raphionacme hirsuta* (28)(+), (46)(+), (47)(+); *Solanum lichtensteinii* (22)(+), (41)(+)
2.1	**Amaranthus hybridus* (22)(+); *Bothriochloa insculpta* (28)(+); *Eragrostis bicolor* (22)(+); *Hyparrhenia filipendula* (28)(+); *Hypoxis hemerocallidea* (28)(+); *Ledebouria burkei* subsp. *burkei* (27)(+)
2.2	*Acrachne racemosa* (50)(+); *Adenia digitata* (50)(+); *Crassula lanceolata* subsp. *transvaalensis* (41)(+), (48)(+); *Cryptolepis oblongifolia* (40)(+), (41)(+); *Cynodon dactylon* (50)(+); *Diheteropogon amplectens* (24)(+), (41)(+); *Diospyros lycioides* (25)(+), (26)(+); *Elionurus muticus* (25)(+); *Eragrostis curvula* (24)(+), (41)(+); *Eriospermum bellendeni* (26)(+), (40)(+); *Euphorbia clavarioides* (24)(+); *Faurea saligna* (40)(1); *Gladiolus* species (25)(+); *Hypoxis acuminata* (25)(+); *Indigofera hedyantha* (41)(+); *Justicia orchioides* (24)(+); *Merremia verecunda* (24)(+), (34)(+); *Neorautanenia ficifolius* (50)(+); *Schizachyrium jeffreysii* (41)(+); Senecio oxyriifolius (41)(+); *Sida chrysantha* (40)(+); *Sonchus* species (41)(+); *Sphedamnocarpus pruriens* (25)(+), (26)(+); *Stipagrostis uniplumis* (49)(+); *Striga asiatica* (24)(+), (47)(+), (50)(+); *Tephrosia elongata* (41)(+); *Triumfetta sonderi* (41)(a); *Tylophora flanaganii* (47)(+); *Vernonia poskeana* (47)(+)
3.	*Asparagus laricinus* (32)(+), (71)(+), (77)(+); *Digitaria monodactyla* (8)(+), (37)(+), (38)(+); *Leucas neuflizeana* (15)(+), (76)(+), (77)(+); *Sida rhombifolia* (10)(+), (37)(+); *Zornia capensis* (8)(+), (15)(+), (16)(+), (42)(+)
3.1	*Andropogon chinensis* (32)(+); *Chamaecrista mimosoides* (11)(+); *Cleome maculata* (7)(+); *Cucumis heptadactylus* (42)(+); *Cyperus obtusiflorus* (35)(+); *Cyphostemma schlechteri* (42)(+); *Dicoma tomentosa* (9)(+); *Eragrostis nindensis* (38)(+); *Eragrostis viscosa* (70)(+), (71)(+); **Euphorbia heterophylla*

	(39)(+); **Flaveria bidentis* (39)(+); *Gisekia pharnacioides* (7)(+), (9)(+); *Gomphocarpus fruticosus* (11)(+); *Grewia bicolor* (42)(+); *Harpagophytum procumbens* (32)(+); *Jasminum streptopus* (9)(+); *Ledebouria apertiflora* (7)(+); *Leucas capensis* (15)(+); *Limeum sulcatum* var. *sulcatum* (7)(+), (15)(+), (16)(+); *Merremia palmata* (42)(+); *Vangueria infausta* (7)(+), (11)(+); *Ximenia americana* (9)(+), (10)(+), (16)(+), (32)(+)
3.2	**Chenopodium album* (36)(+); *Commiphora glandulosa* (76)(+); *Conyza podocephala* (36)(+); *Cymbopogon nardus* (77)(1); *Eragrostis lehmanniana* (37)(+); *Eriospermum porphyrium* (76)(+); *Holubia saccata* (37)(+); *Laggera decurrens* (76)(+); *Ptycholobium plicatum* (12)(+), (77)(+); *Senecio inaequidens* (77)(+); *Sporobolus nitens* (76)(+)
4.	*Abutilon grandiflorum* (33)(+); *Acacia robusta* (33)(a); *Ancylobotrys petersiana* (72)(+); *Asparagus racemosus* (33)(a); *Barleria meyeriana* (3)(+); *Cheilanthes* species (73)(+); *Cheilanthes viridis* (215)(+); *Commelina erecta* (215)(+); *Crotalaria lotoides* (214)(+); *Cussonia paniculata* (214)(+); *Cyperus fulgens* (214)(+); *Dicoma* species (215)(+); *Erythrophysa transvaalensis* (72)(+); *Ficus cordata* subsp. *salicifolia* (73)(+), (214)(+); *Ficus thonnigii* (214)(+); *Gymnosporia polyacantha* (33)(+); *Hermbstaedtia odorata* (73)(+); *Hibiscus calyphyllus* (72)(a); *Justicia protracta* (73)(+); *Kalanchoe paniculata* (33)(+); *Leonotis leonurus* (72)(+), (73)(+); **Opuntia ficus-indica* (73)(+); *Plumbago zeylanica* (33)(1); *Tephrosia longipes* (72)(+); *Viscum rotundifolium* (73)(+)
No specific community	*Acalypha villicaulis* (24)(+), (28)(1), (41)(+), (77)(+); *Acrotome inflata* (40)(+), (42)(+), (46)(+), (49)(+), (51)(+); *Aerva leucura* (9)(+), (25)(+), (76)(+), (77)(+), (215)(+); *Aristida scabrivalvis* (22)(+), (40)(+), (184)(+); *Asparagus setaceus* (32)(+), (37)(+), (215)(a); **Bidens pilosa* (8)(+), (73)(+); *Brachiaria eruciformis* (34)(+), 39(1); *Bulbostylis hispidula* var. *pyriformis* (16)(+), (25)(1); **Chenopodium carinatum* (15)(+), (16)(+), (22)(+), (38)(+), (40)(+), (49)(+), (50)(+); *Citrullus lanatus* (22)(+), (32)(+), (39)(+); *Cleome rubella* (34)(+), (40)(+), (47)(+), (70)(+); *Commelina livingstonii* (32)(+), (38)(+), (39)(+), (47)(+); *Commiphora schimperi* (72)(+), (76)(1); *Crotalaria globifera* (8)(b), (33)(+), (70)(1); *Cucumis metuliferus* (21)(+), (23)(+), (43)(+); *Ehretia rigida* (12)(+), (26)(+), (27)(+), (33)(+), (49)(+), (214)(+); *Eragrostis aspera* (32)(+), (36)(+), (37)(+), (39)(a); *Eragrostis biflora* (9)(+), (41)(+), (51)(+); *Euclea natalensis* (27)(1), (33)(+), (47)(a); *Flueggea virosa* (12)(+), (72)(+), (73)(+), (77)(+); *Hermannia glanduligera* (7)(+), (10)(+), (32)(a), (47)(+); *Hermbstaedtia linearis* (26)(+), (27)(+); *Hirpicium bechuanense* (28)(+), (77)(+); *Indigofera heterotricha* (12)(+), (15)(+), (22)(+), (49)(+), (64)(1); *Indigofera rhytidocarpa* subsp. *rhytidocarpa* (36)(+), (37)(+), (39)(+), (44)(+), (45)(+), (50)(+); *Ipomoea*

	magnusiana (24)(+), (214)(+); *Jatropha zeyheri* (12)(+), (26)(+); *Justicia betonica* (26)(+), (33)(+), (71)(+); *Kyllinga alba* subsp. *alba* (7)(+), (8)(+), (10)(+), (40)(+), (41)(+), (70)(+); *Melhania prostrata* (9)(+), (11)(+), (12)(+), (44)(+), (45)(+), (77)(+); *Mollugo cerviana* (26)(+), (33)(+); *Momordica balsamina* (16)(+), (49)(+); *Monechma debile* (10)(+), (73)(+); *Nidorella anomala* (24)(+), (35)(+), (36)(+), (39)(+), (42)(+), (46)(+), (182)(+), (183)(+); *Ocimum americanum* var. *americanum* (77)(+), (182)(+); *Ocimum angustifolium* (11)(+), (33)(+), (44)(+); *Oxalis smithiana* (50)(+), (76)(1), (89)(+), (183)(+), (215)(+); *Panicum coloratum* (45)(+), (77)(1); *Pavonia senegalensis* (45)(+), (215)(1); *Peltophorum africanum* (8)(+), (35)(a), (77)(+), (214)(+), (215)(+); *Phyllanthus incurvus* (25)(+), (77)(+), (79)(+); *Polygala sphenoptera* (16)(+), (42)(+), (71)(1), (214)(+), (215)(+); *Pupalia lappacea* (73)(+), (77)(+); *Rhoicissus tridentata* (27)(+), (36)(+), (38)(+), (50)(+), (72)(+); *Rhus pyroides* (21)(+), (45)(+); *Rhynchosia densiflora* subsp. *chrysadenia* (22)(+), (36)(+), (77)(+), (183)(+); *Ruellia cordata* (24)(+), (25)(+), (45)(+), (47)(+); *Senecio harveianus* (27)(+), (38)(+), (40)(+), (46)(+), (47)(+); *Sesamum triphyllum* (7)(+), (9)(+), (15)(+), (26)(+), (33)(+), (46)(+), (50)(+), (183)(+); *Setaria pumila* (9)(+), (76)(+), (182)(+); *Solanum retroflexum* (27)(+), (36)(+); *Solanum rubetorum* (41)(+), (182)(+); *Stylosanthes fruticosa* (38)(+), (40)(+), (44)(+), (50)(+), (51)(+), (76)(+), (182)(+); *Tephrosia capensis* (70)(+), (71)(+); *Terminalia sericea* (15)(+), (23)(a), (34)(+), (35)(1), (43)(1), (44)(+); *Thesium utile* (32)(+), (34)(+), (184)(+), (185)(+); *Tragia rupestris* (16)(+), (215)(+); *Tribulus terrestris* (22)(+), (184)(+); *Vigna frutescens* (27)(+), (32)(+), (38)(+), (40)(+), (64)(+), (214)(+); *Vigna vexillata* (23)(+), (25)(+), (34)(+); *Ximenia caffra* (23)(+), (184)(+) * Alien species

Chapter 7

Classification and description of the Fb land type

7.1 Introduction

Although the Fb land type covered a smaller part of the Central Corridor Area (CCA), it was very heterogeneous and consisted of a wide variety of plant species and plant communities. A total of 46 relevés were completed for this land type.

According to the Land Type Survey Staff (1988) the F land types were intended to accommodate pedologically young landscapes that are not predominantly rock and not predominantly alluvial or aeolian. The Mispah and Glenrosa soil forms are found most frequently in these land types. Other soil forms may also be found in these land types, providing they don't qualify it for any of the other land types. Shallow and deep soil of the Oakleaf form (usually on upland sites) developed by rock weathering are accommodated here. The Fb land type usually indicates land where lime occurs regularly (there need not be much of it) in one or more valley bottom soil (Land Type Survey Staff, 1988).

The Fb land type in the CCA fell into the Dwarsberg-Swartruggens Mountain Bushveld vegetation type as described by Mucina & Rutherford (2006). They described this vegetation types as having variable vegetation of which the structure depends on the slope, exposure, aspect and local habitat. Various combinations of tree and shrub strata, often with a dense grass stratum are found. Bush clumps also occur (Mucina & Rutherford, 2006).

Mucina & Rutherford (2006) described the geology of the Dwarsberg-Swartruggens Mountain Bushveld as shales, quartzites and andesites of the Pretoria Group (Transvaal Supergroup). It is characterized by stony shallow soil of the Glenrosa and Mispah soil forms, with some deep, freely drained soil (Mucina & Rutherford, 2006).

7.2 Plant communities of the Fb land type

The Fb land type includes the following seven communities and four sub-communities (Figure 7.1, Table 7.1), namely:

1. *Monsonia angustifolia - Combretum apiculatum* Community
2. *Sphedamnocarpus pruriens - Terminalia sericea* Community
3. *Enneapogon cenchroides - Peltophorum africanum* Community
4. *Acacia mellifera - Bridelia mollis* Community
5. *Blepharis maderaspatensis - Croton gratissimus* Community
6. *Bulbostylis hispidula* var. *pyriformis - Combretum zeyheri* Community
    6.1 *Gomphocarpus fruticosus - Combretum molle* Sub-community
    6.2 *Eragrostis biflora - Burkea africana* Sub-community
7. *Spirostachys africana - Panicum maximum* Community
    7.1 *Pouzolzia mixta - Croton gratissimus* Sub-community
    7.2 *Abutilon ramosum - Pappea capensis* Sub-community

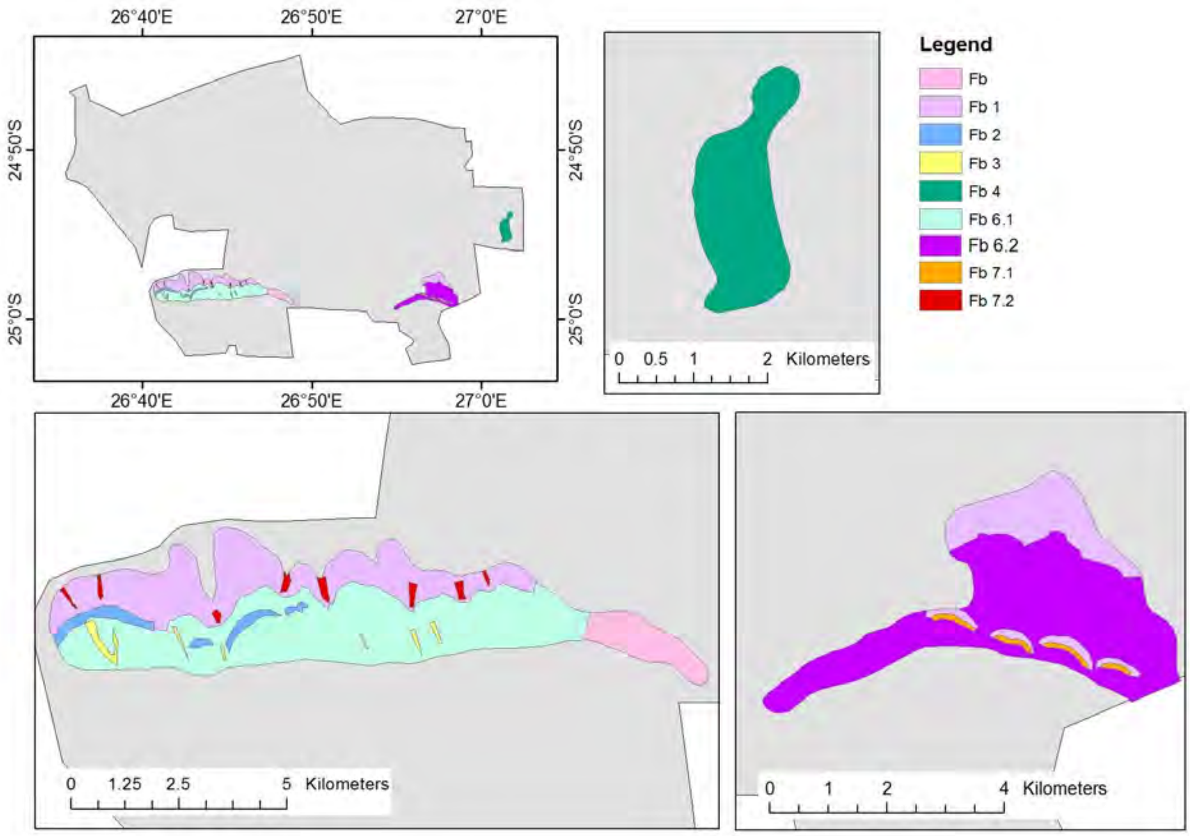

Figure 7.1 Map of the Fb land type. The first map shows the location of the Fb land type in the Central Corridor Area. The other three maps enlarge the three parts of the Fb land type, so that the different communities can be distinguished. Communities 3 and 7.2 were found in ravines on the southern and northern slopes respectively. Community 5 could not be mapped, because it was found in small patches.

Table 7.1 Phytosociological table of the Fb land type of the Central Corridor Area of the proposed Heritage Park

Site number																						1	1																				1	1	1	1
	7	7	7	7	5	5	7	7	8	8	8	8	7	7	8	8	4	4	6	9	9	1	1	3	3	5	6	6	6	6	6	9	9	5	5	9	9	5	5	9	9	5	0	0	1	1
	3	3	4	4	7	7	0	0	3	3	4	4	9	9	2	2	9	9	3	6	7	1	1	3	3	9	1	1	3	7	7	8	8	5	5	5	5	6	6	6	7	9	9	9	0	0
Relevé number	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			1	1	1	2	2			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2
	4	4	4	4	1	1	3	3	6	6	6	6	5	5	6	6	9	9	2	9	9	2	2	6	6	1	2	2	2	3	3	9	9	0	0	8	8	1	1	9	9	1	1	1	1	1
	4	5	6	7	2	3	8	9	4	5	6	7	6	7	2	3	6	7	5	1	3	1	2	4	5	7	0	1	4	2	3	4	5	7	9	8	9	0	1	0	2	6	6	7	8	9
Number of species per relevé	3	2	3	2	5	4	5	4	5	5	5	4	5	6	6	6	7	6	5	5	5	5	4	5	4	4	4	5	4	6	5	5	6	6	5	7	5	4	5	4	3	4	4	5	4	4
	1	7	2	1	0	2	5	2	4	4	7	4	7	5	0	1	1	4	1	6	9	5	8	2	0	3	7	3	3	5	7	7	5	5	6	7	8	4	0	9	9	5	6	3	1	8
Communities	1								2				3				4			5				6.1								6.2						7.1				7.2				
Species group A (Diagnostic species of Community 1)																																														
Monsonia angustifolia	+	+	+	+	+	+	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Crotalaria sphaerocarpa	+	1	+	1	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Acacia tortilis	+	+	+	.	1	.	+	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.	+	+	.	.
Nidorella resedifolia s. *resedifolia*	+	a	1	.	.	.	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
**Zinnia peruviana*	.	.	+	.	+	1	1	+	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	+
Aristida adscensionis	1	.	+	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.
Chamaecrista mimosoides	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Indigofera species	.	.	+	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Thesium utile	1	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Combretum hereroense	.	.	.	.	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Indigofera heterotricha	.	.	.	.	.	+	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Species group B (Diagnostic species of Community 2)																																														
Sphedamnocarpus pruriens	.	.	.	.	.	.	.	.	1	a	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Chamaecrista biensis	.	.	.	.	.	.	.	.	+	1	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Hypoestes forskaolii	.	.	.	.	.	.	.	.	1	1	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+	.
Schmidtia pappophoroides	.	.	+	.	.	.	1	.	1	+	+	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Corchorus asplenifolius	.	.	.	.	.	.	.	.	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Ornithogalum glaucescens	.	.	.	.	.	.	.	.	+	+	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Euphorbia inaequilatera	+	.	.	.	.	.	.	.	+	+	+	+	+	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Hermannia stellulata	.	.	.	.	.	.	.	.	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Limeum viscosum	.	.	.	.	.	.	.	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hermbstaedtia linearis	.	.	.	.	.	.	.	.	+	.	+	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Acacia nigrescens	.	.	.	.	.	.	.	.	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cyperus obtusiflorus	.	.	.	.	.	.	.	.	.	+	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	+	.	.	.	.	.	.	.	.	.

Table 7.1 (continued)																																														
Relevé number	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			1	1	1	2	2			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2
	4	4	4	4	1	1	3	3	6	6	6	6	5	5	6	6	9	9	2	9	9	2	2	6	6	1	2	2	2	3	3	9	9	0	0	8	8	1	1	9	9	1	1	1	1	1
	4	5	6	7	2	3	8	9	4	5	6	7	6	7	2	3	6	7	5	1	3	1	2	4	5	7	0	1	4	2	3	4	5	7	9	8	9	0	1	0	2	6	6	7	8	9
Communities	1								2				3				4			5				6.1								6.2						7.1				7.2				
Species group C (Diagnostic species of Community 3)																																														
Enneapogon cenchroides	.	.	.	.	.	.	+	.	.	.	.	.	+	+	+	+	.	+	a	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.
Ocimum americanum v. *americanum*	.	.	.	.	.	.	.	.	.	.	.	.	.	a	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.
Cleome oxyphylla v. *oxyphylla*	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	+	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Eustachys paspaloides	.	.	.	.	.	.	.	.	.	.	.	+	.	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.
Cyperus fulgens	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Tragia meyeriana	.	.	.	.	.	.	.	.	.	.	.	.	+	1	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Barleria pretoriensis	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	1	.	.	+	+	.	.
Species group D (Diagnostic species of Community 4)																																														
Acacia mellifera	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
Sida cordifolia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Tephrosia elongata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Vernonia poskeana	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Senecio harveianus	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sida spinosa	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Species group E (Diagnostic species of Community 5)																																														
Blepharis maderaspatensis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	.	.	.	+
Ipomoea obscura	+	.	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+	+	.	.	.	.	.
Indigastrum costatum s. *macrum*	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Tephrosia rhodesica	.	.	.	.	.	.	+	.	.	.	.	.	1	.	.	.	.	.	.	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.
Ancylobotrys petersiana	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Strychnos spinosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Talinum caffrum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.
Melhania acuminata	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
Rhynchosia minima	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
Gymnosporia tenuispina	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Table 7.1 (continued)																																														
Relevé number	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			1	1	1	2	2			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2
	4	4	4	4	1	1	3	3	6	6	6	6	5	5	6	6	9	9	2	9	9	2	2	6	6	1	2	2	2	3	3	9	9	0	0	8	8	1	1	9	9	1	1	1	1	1
	4	5	6	7	2	3	8	9	4	5	6	7	6	7	2	3	6	7	5	1	3	1	2	4	5	7	0	1	4	2	3	4	5	7	9	8	9	0	1	0	2	6	6	7	8	9
Communities	1								2				3				4			5				6.1								6.2						7.1				7.2				
Species group F																																														
Andropogon chinensis	1	a	+	.	.	1	+	.	+	1	+	+	+	.	.	.	1	+	.	1	+	1	1	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.
Brachiaria nigropedata	1	1	a	.	1	.	1	+	+	1	+	1	.	.	1	+	.	+	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Brachiaria deflexa	.	.	.	.	.	.	+	+	.	.	.	.	+	+	+	+	a	+	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	1	.	+
Setaria pumila	+	.	.	.	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	a	1	+	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	+	.	.	.
Species group G (Diagnostic species of Community 6)																																														
Bulbostylis hispidula v. *pyriformis*	.	.	.	.	.	.	.	.	+	.	+	.	+	.	.	.	.	.	.	.	.	.	.	1	1	.	1	1	+	a	+	+	+	.	.	+	+	.	.	.	.	.	.	.	.	.
Aristida meridionalis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	a	b	b	b	a	+	b	.	a	b	.	.	.	.	.	.	.	.	.	.	.	.	.
Indigofera comosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	1	+	1	+	+	1	.	.	1	+	+	+	.	.	.	.	.	.	.	.	.	.	.
Hermannia tomentosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+	.	.	.	.	.	+	+	.	.	+	+	+	+	1	+	+	.	.	.	.	.	.	.	.	.
**Tagetes minuta*	.	+	.	.	.	1	.	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	1	.	.	.	+	.	+	+	+	+	1	.	.	.	.	.	.	.	.	.
Eragrostis curvula	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	.	.	1	.	.	.	.	.	+	1	+	.	.	.	.	.	.	.	.	.	.
Strychnos pungens	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	+	+	.	.	.	.	+	.	.	1	.	.	+	.	.	.	.	.	.	.	.	.
Hibiscus cannabinus	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.
Species group H (Diagnostic species of Sub-community 6.1)																																														
Gomphocarpus fruticosus	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	+	+	+	+	+	+	+	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Xerophyta retinervis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	+	.	.	.	+	+	+	a	1	1	1	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Schizachyrium jeffreysii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	+	.	a	+	.	b	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.
Leucas martinicensis	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	+	.	.	.	+	+	+	+	1	.	+	.	.	.	.	+	.	.	.	+	+	.	.	.
Indigofera filipes	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	1	.	.	.	.	.	.	+	+	.	.	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Englerophytum magalismontanum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	+	.	.	r	+	+	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.
Vitex zeyheri	.	.	1	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	+	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Trichoneura grandiglumis	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Eragrostis aspera	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	+	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.
Indigofera nebrowniana	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	1	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.
Ipomoea coscinosperma	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	+	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.
Salsola capensis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Canthium gilfillanii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	a	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Table 7.1 (continued)

Relevé number	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			1	1	1	2	2			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2
	4	4	4	4	1	1	3	3	6	6	6	6	5	5	6	6	9	9	2	9	9	2	2	6	6	1	2	2	2	3	3	9	9	0	0	8	8	1	1	9	9	1	1	1	1	1
	4	5	6	7	2	3	8	9	4	5	6	7	6	7	2	3	6	7	5	1	3	1	2	4	5	7	0	1	4	2	3	4	5	7	9	8	9	0	1	0	2	6	6	7	8	9
Communities	1								2				3				4			5				6.1								6.2						7.1				7.2				
Species group I																																														
Ipomoea magnusiana	.	.	.	.	.	.	+	.	.	.	.	.	+	.	+	+	.	.	.	+	.	.	.	+	+	.	.	.	1	+	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.
Euclea natalensis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	+	.	.	.	.	.	+	.	.	+	.	.	+	.	.	.	.	.	1	+	.	.	.	.	.	.
Hibiscus engleri	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	1	+	.	.	+	+	.	.	+	+	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ficus glumosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	a	b	.	.	.	.	.	.	.	.	.	.	.	+	.	+	+	.	.	+	.	.	.	.	.	.	+	.	.	.	.	.
Melinis nerviglumis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	b	.	.	.	.	a	1	.	.	.	+	b	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Setaria lindenbergiana	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	b	.	.	.	.	.	.	.	1	.	.	1	.	.	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Species group J (Diagnostic species of Sub-community 6.2)																																														
Eragrostis biflora	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	+	+	.	.	.	.	.	.	+	+	+	+	1	1	.	.	.	.	1	.	.	.	.
Ochna pulchra	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	+	+	1	+	+	+	.	.	.	.	.	.	.	.	.
Pentarrhinum insipidum	+	.	1	.	.	.	+	.	.	.	.	.	.	.	.	.	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+	+	.	.	.	.	.	.	.	.	.
Strychnos madagascariensis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	+	.	+	+	.	.	+	+	.	.	.	+	.	.	.	.	.
Cryptolepis oblongifolia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+	+	+	+	.	.	.	.	.	.	.	.	.
Diheteropogon filifolius	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	b	a	.	.	.	.	.	.	.	.	.
Loudetia simplex	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	+	a	.	.	.	.	.	.	.	.	.
Sida rhombifolia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+	+	.	+	.	+	.	.	.	.	.	.
Faurea saligna	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	1	.	.	.	.	.	.	.	.	.
Cymbopogon nardus	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	1	.	.	.	.	.	.	.	.	.
**Bidens pilosa*	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.
Spermacoce senensis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.
Diheteropogon amplectens	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	a	1	.	.	.	.	.	.	.	.	.
Schizachyrium sanguineum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	+	.	.	.	.	.	.	.	.	.
**Gomphrena celosioides*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	.	.	.	.	.	+	+	.	.	+	.	.	.	.	.	.	.	.	.	.
Clerodendrum suffruticosum v. *suffruticosum*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	a	.	.	.	.	.	.	.	.	.	.

Table 7.1 (continued)

Relevé number	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			1	1	1	2	2			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2
	4	4	4	4	1	1	3	3	6	6	6	6	5	5	6	6	9	9	2	9	9	2	2	6	6	1	2	2	2	3	3	9	9	0	0	8	8	1	1	9	9	1	1	1	1	1
	4	5	6	7	2	3	8	9	4	5	6	7	6	7	2	3	6	7	5	1	3	1	2	4	5	7	0	1	4	2	3	4	5	7	9	8	9	0	1	0	2	6	6	7	8	9
Communities	1								2				3				4			5				6.1								6.2						7.1				7.2				
Species group K																																														
Kyphocarpa angustifolia	.	.	.	.	+	.	.	.	.	+	.	.	.	.	.	.	+	.	+	+	+	+	.	+	+	1	1	1	1	1	.	+	+	.	.	+	+	.	+	.	.	+	.	.	.	.
Tephrosia longipes	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+	.	.	.	.	.	+	1	+	1	.	.	+	.	+	+	.	.	.	+	+	+	.	.	.	.	.	.	.	.	.
Tragia rupestris	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	1	+	.	+	+	+	.	.	.	.	.	.	.	.	.	.	+	+	+	+	1	.	.	.	.	.	.	.	.	.
Phyllanthus parvulus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	+	+	+	.	.	.	.	+	+	.	+	.	.	+	.	.	.	.	.	.	.	+	.	.
Species group L																																														
Combretum zeyheri	.	.	.	.	.	.	.	.	+	.	+	1	1	a	+	a	+	a	a	+	1	+	.	a	a	1	b	a	a	b	a	b	a	a	b	a	b	.	.	.	.	.	.	.	.	.
Waltheria indica	.	.	.	.	+	.	.	.	+	+	+	+	+	+	+	+	+	+	+	b	a	a	a	a	1	+	1	1	1	1	+	a	a	+	a	1	a	.	1	+	.	.	.	.	.	.
Digitaria eriantha	.	.	.	.	.	.	.	.	1	a	b	b	1	a	b	1	+	.	.	.	.	1	+	a	1	.	.	+	a	1	a	a	a	b	+	1	1	.	.	.	.	.	.	.	.	.
Eragrostis rigidior	.	.	.	.	.	.	1	.	+	+	+	+	+	+	.	.	+	+	1	.	1	+	.	.	.	+	1	1	+	+	.	+	1	+	+	.	.	.	1	.	.	.	.	.	.	.
Burkea africana	.	.	.	.	.	.	.	.	+	+	+	+	.	.	.	+	.	+	.	.	.	.	.	1	1	.	1	1	.	+	1	1	a	a	a	b	b	.	.	.	.	.	.	.	.	.
Oldenlandia herbacea	.	.	.	.	.	.	.	.	+	+	.	.	.	+	+	.	+	+	.	+	.	.	.	+	+	+	a	a	a	1	+	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.
Polygala sphenoptera	.	.	.	.	.	.	.	.	1	+	1	+	+	.	.	+	+	.	.	.	.	+	+	.	.	.	.	+	.	+	+	+	1	+	+	+	+	.	.	+	.	.	.	.	.	.
Commelina africana	.	.	.	.	.	.	.	.	+	+	+	.	.	+	+	1	.	+	.	.	.	+	+	+	+	+	.	.	+	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Phyllanthus incurvus	.	.	.	.	.	+	.	.	+	+	+	.	+	+	+	+	.	1	+	.	+	.	.	.	.	.	+	.	+	.	.	+	.	+	+	.	+	.	.	.	.	.	+	.	.	.
Terminalia sericea	.	.	.	.	.	.	.	.	b	b	b	b	.	.	.	.	.	.	+	.	+	.	.	.	.	.	1	+	.	+	+	+	1	+	+	1	1	.	.	.	.	.	.	.	.	.
Aristida congesta s. *congesta*	.	.	.	.	.	.	.	.	+	+	+	+	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	1	.	+	.	.	+	+	+	+	+	.	.	.	.	.	.	.	.	.
Gisekia pharnacioides	.	.	.	.	.	.	.	.	+	+	+	.	+	.	+	.	.	+	.	.	+	.	.	+	+	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Pogonarthria squarrosa	.	.	.	.	.	.	.	.	b	1	a	1	+	+	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Ozoroa paniculosa	.	.	.	.	.	.	.	.	.	a	+	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	+	+	1	+	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Rhus leptodictya	.	.	.	.	.	.	+	.	+	.	.	+	.	.	.	.	+	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	+	+	+	.	.	.	.	.	+	.	+	.	.
Hermannia glanduligera	.	.	.	.	.	.	+	.	+	+	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	+	.	.	.	.	1	.	.	+	+	.	.	.	.	.	.	.	.	.
Kyllinga alba s. *alba*	.	.	.	.	.	.	.	.	+	.	.	+	+	+	.	.	.	.	1	.	.	.	.	.	.	+	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Kohautia amatymbica	.	+	.	.	.	.	.	.	.	+	+	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Table 7.1 (continued)																																														
Relevé number	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			1	1	1	2	2			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2
	4	4	4	4	1	1	3	3	6	6	6	6	5	5	6	6	9	9	2	9	9	2	2	6	6	1	2	2	2	3	3	9	9	0	0	8	8	1	1	9	9	1	1	1	1	1
	4	5	6	7	2	3	8	9	4	5	6	7	6	7	2	3	6	7	5	1	3	1	2	4	5	7	0	1	4	2	3	4	5	7	9	8	9	0	1	0	2	6	6	7	8	9
Communities	1								2				3				4			5				6.1								6.2						7.1				7.2				
Species group M																																														
Tephrosia purpurea	+	.	+	+	1	1	+	.	1	.	.	+	.	+	+	+	.	.	1	+	1	+	+	+	+	+	+	+	+	+	+	+	1	.	.	+	+	.	+	.	.	.	.	.	.	.
Heteropogon contortus	+	+	+	+	a	+	.	.	1	a	1	a	1	a	.	+	a	.	1	+	.	.	.	.	+	.	+	1	.	+	+	.	.	+	+	a	1	.	+	.	.	.	.	.	.	.
Chrysopogon serrulatus	1	3	1	1	+	a	a	a	.	.	+	+	1	1	+	a	1	a	.	.	a	+	+	.	+	.	.	+	.	+	b	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.
Solanum panduriforme	+	.	.	.	+	+	+	.	+	+	+	.	+	+	+	+	.	+	1	.	.	.	+	.	+	+	+	+	.	+	.	+	1	+	.	.	+	.	.	.	.	.	.	+	.	.
Vangueria infausta	.	.	.	.	1	+	.	.	.	+	.	.	+	+	+	+	.	.	.	1	+	.	.	.	.	.	.	.	.	+	+	1	+	+	+	+	+	.	.	.	.	.	.	.	.	.
**Schkuhria pinnata*	.	.	.	.	+	+	+	+	+	+	.	.	+	.	.	.	+	+	b	.	.	+	1	+	.	.	+	+	+	.	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Chascanum hederaceum	.	+	+	+	+	.	.	.	.	1	+	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	+	.	+	.	+	+	+	.	.	.	.	.	.	.	.	.
Dombeya rotundifolia	.	.	.	.	+	.	+	.	.	+	+	.	.	+	.	1	1	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	+	1	+	.	.	.	.	.	.	.	.	.	.	.
Acacia caffra	.	+	.	+	.	.	+	.	.	.	+	.	.	+	.	+	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+	.	+	+	.	.	.	.	.	.	.	.	.
Indigofera daleoides	+	+	+	.	.	.	.	.	.	1	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	.	.	.	.	.	.
Communities	1								2				3				4			5				6.1								6.2						7.1				7.2				
Species group N (Diagnostic species of Community 7)																																														
Spirostachys africana	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	b	+	b	b	4	3	b	4	b
Enteropogon macrostachyus	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	a	.	a	b	b	a	a	a	a
Pappea capensis	.	.	.	.	.	+	.	+	.	.	.	.	.	+	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	+	+	+	+	1	b	1	+	b
Pupalia lappacea	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	+	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	+	1	1	.	1	1	a	+
Grewia bicolor	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	+	+	a	1	1
Secamone parvifolia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+	+	.	1	.	1	1	3
Ehretia rigida	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	+	+	+	.	+	.	+
Hibiscus micranthus	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	1	+	.	.	+	.	.	+	+
Euclea undulata	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	+	.	.	+	+	+
Ruellia cordata	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	+	.	.	+	+	.	+
Boscia albitrunca	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+

Table 7.1 (continued)																																														
Relevé number	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			1	1	1	2	2			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2
	4	4	4	4	1	1	3	3	6	6	6	6	5	5	6	6	9	9	2	9	9	2	2	6	6	1	2	2	2	3	3	9	9	0	0	8	8	1	1	9	9	1	1	1	1	1
	4	5	6	7	2	3	8	9	4	5	6	7	6	7	2	3	6	7	5	1	3	1	2	4	5	7	0	1	4	2	3	4	5	7	9	8	9	0	1	0	2	6	6	7	8	9
Species group O (Diagnostic species of Sub-community 7.1)																																														
Pouzolzia mixta	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	a	1	1	+	.	.	.	.	.
Pavonia senegalensis	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	a	+	+	.	.	.	.
Sansevieria aethiopica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	+	.	.	.	.	.
Gymnosporia heterophylla	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	+	+	.	.	.	.
Maerua angolensis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	.	+	.	.	.
Species group P																																														
Pellaea calomelanos v. *calomelanos*	.	.	.	.	.	+	.	.	.	.	.	.	+	+	+	+	+	+	+	+	+	+	+	+	+	1	.	+	+	1	+	+	+	1	+	+	1	+	+	+	+	.	.	.	+	.
Rhynchosia totta	.	.	.	.	1	.	.	1	.	.	.	.	b	a	+	+	+	1	.	+	.	+	.	+	+	+	.	.	.	.	.	+	1	+	.	.	.	.	+	+	+	.	.	.	.	.
Pavonia transvaalensis	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	+	+	+	.	.	.	.	.	+	+	.	+	+	+	+	1	+	.	+	+	.	.	.	.	.	.
Melhania prostrata	.	.	.	.	.	.	.	+	.	.	+	.	+	+	+	+	+	+	+	.	+	.	.	.	.	.	.	.	.	.	+	.	+	.	+	1	.	+	+	+	.	+	.	.	.	.
Psiadia punctulata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	+	+	.	.	.	a	.	.	.	.	.	.	.	+	+	+	.	b	1	b	a	+	.	.	.	.
Canthium mundianum	.	.	.	.	.	.	.	.	.	.	.	.	1	+	+	.	.	+	.	+	.	+	1	.	.	+	.	.	.	.	+	.	.	.	.	+	.	+	+	.	1	.	.	.	.	.

Table 7.1 (continued)

Relevé number	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			1	1	1	2	2			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2
	4	4	4	4	1	1	3	3	6	6	6	6	5	5	6	6	9	9	2	9	9	2	2	6	6	1	2	2	2	3	3	9	9	0	0	8	8	1	1	9	9	1	1	1	1	1
	4	5	6	7	2	3	8	9	4	5	6	7	6	7	2	3	6	7	5	1	3	1	2	4	5	7	0	1	4	2	3	4	5	7	9	8	9	0	1	0	2	6	6	7	8	9
Communities	1								2				3				4			5				6.1								6.2						7.1				7.2				
Species group Q																																														
Pogonarthria squarrosa	1	.	b	+	a	+	1	a	1	1	1	.	1	+	+	.	1	a	+	b	b	b	a	+	+	1	+	1	+	+	+	1	1	+	+	+	+	.	b	.	.	.	.	.	.	.
Combretum apiculatum	b	1	b	1	a	a	1	b	+	1	+	+	a	+	.	.	b	a	.	.	+	a	+	+	.	.	.	.	.	.	.	+	1	.	.	+	.	.	1	+	+	.	.	.	.	1
Lannea discolor	1	.	.	.	.	1	.	.	1	.	.	.	+	a	+	+	.	+	+	+	.	.	+	+	+	+	+	1	+	+	a	.	.	.	.	+	+	+	1	.	.	.	.	.	.	.
Ceratotheca triloba	.	.	.	.	+	+	+	+	.	.	.	.	+	.	.	.	.	.	+	+	.	+	.	.	+	+	+	+	.	+	.	.	+	+	.	+	.	.	+	.	.	.	.	.	.	.
Species group R (Diagnostic species of Sub-community 7.2)																																														
Abutilon angulatum	.	.	.	.	.	+	+	1	.	.	.	.	+	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+	+
Abutilon ramosum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	b	a	b	a
Acalypa glabrata v. *pilosa*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+	a	1
Acacia karroo	.	.	.	.	.	1	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	b	b	+	.
Boscia foetida	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	1	+	.
Triumfetta annua	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	a	+	.	.	.	.	.	.	.	.	.	+	+	+	+
Pavonia burchellii	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	+	+	.	+
Plumbago zeylanica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.	1	1	+	.
Acacia nilotica	.	.	.	.	+	.	.	.	1	+	.	+	.	1	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	+	b
Acacia burkei	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	1	+
Melhania acuminata v. *agnosta*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	1
Digitaria sanguinalis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	.	.	.
Dicliptera clinopodia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+	.	.
Species group S																																														
Croton gratissimus	.	.	.	.	.	.	.	+	.	.	.	.	1	.	1	.	.	1	.	b	3	a	a	.	.	.	.	.	.	.	+	.	.	.	.	.	.	b	3	b	b	1	1	.	1	.
Commelina benghalensis	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	+	.	+	+	.	.	+	+	.	.	.	.	.	+	.	.	+	.	.	.	+	.	.	.	+	.	+	+	+	.	+
Indigofera vicioides v. *vicioides*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.	+	.	+

Table 7.1 (continued)																																													
Relevé number	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			1	1	1	2	2			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2
	4	4	4	4	1	1	3	3	6	6	6	6	5	5	6	6	9	9	2	9	9	2	2	6	6	1	2	2	2	3	3	9	9	0	0	8	8	1	1	9	9	1	1	1	1	1
	4	5	6	7	2	3	8	9	4	5	6	7	6	7	2	3	6	7	5	1	3	1	2	4	5	7	0	1	4	2	3	4	5	7	9	8	9	0	1	0	2	6	6	7	8	9
Communities	1								2				3				4			5				6.1								6.2						7.1				7.2				
Species group T																																														
Dichrostachys cinerea	b	+	a	a	b	a	a	.	+	+	+	.	+	+	.	+	a	1	.	1	+	1	+	.	.	+	.	+	.	+	.	+	+	1	+	1	+	a	.	a	+	1	1	a	+	a
Grewia monticola	+	+	.	.	1	1	+	a	+	+	.	.	1	1	+	+	a	1	1	.	1	+	+	+	.	.	+	+	.	+	+	.	+	+	+	.	.	+	+	1	+	.	a	+	1	+
Combretum molle	.	.	.	.	.	.	.	+	1	1	+	.	a	+	1	b	b	.	1	a	a	b	a	a	1	b	a	1	b	a	1	a	a	a	1	.	a	.	.	.	+	.	+	+	a	+
Panicum maximum	.	.	.	.	+	.	+	+	+	.	.	.	a	3	3	b	a	+	+	1	+	+	+	+	.	+	.	+	+	.	1	.	+	.	.	+	.	a	+	a	1	+	b	a	3	3
**Bidens bipinnata*	+	.	.	.	+	+	+	+	+	+	+	+	a	+	1	+	.	.	+	+	.	+	+	+	.	.	+	.	+	+	+	1	+	+	+	+	+	.	+	.	.	+	+	.	.	.
Bridelia mollis	.	.	.	.	+	.	1	.	.	+	1	.	1	a	a	+	a	b	+	.	+	.	+	+	.	+	a	.	1	+	1	1	1	+	+	+	+	.	.	.	.	.	+	+	+	.
**Achyranthes aspera*	1	1	1	+	.	.	+	+	+	.	.	.	+	+	1	+	.	+	1	+	.	+	+	.	.	.	+	+	.	.	.	.	+	.	.	.	.	1	+	+	+	b	a	a	+	+
Grewia flavescens	.	.	.	.	+	+	.	+	.	.	+	.	.	+	+	+	1	+	+	+	.	+	+	.	+	+	.	.	+	.	.	.	+	1	+	.	.	a	+	.	1	a	+	+	1	1
Evolvulus alsinoides	+	+	.	.	+	+	+	.	+	.	+	.	.	.	.	.	+	+	+	+	.	+	+	+	+	.	+	+	.	+	.	+	+	.	+	+	+	.	.	+	.	.	+	.	+	+
Peltophorum africanum	.	.	.	.	1	.	1	.	+	+	+	+	a	b	1	1	1	.	1	+	+	.	.	+	.	1	+	.	1	+	1	.	.	1	.	+	.	.	+	.	.	.	.	+	+	1
Aristida canescens	3	1	a	4	b	b	b	b	.	+	.	.	.	.	.	.	1	1	+	+	+	a	1	+	.	.	+	+	1	.	1	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.
Sclerocarya birrea	a	a	.	1	a	b	a	a	.	+	.	.	.	.	+	.	.	.	+	+	+	.	+	+	.	1	.	.	.	+	.	.	.	.	.	.	.	1	+	.	+	.	+	+	a	+
Acalypha indica	+	+	+	.	+	+	+	1	.	.	.	.	+	+	+	1	.	.	+	.	.	+	.	+	.	.	.	.	+	.	1	.	.	.	.	.	.	+	.	.	.	1	+	+	+	+
Lantana rugosa	+	+	+	.	+	+	+	+	.	.	+	.	+	+	+	+	1	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.	+	+	.	.	.	+	+
Ximenia americana	.	+	+	.	.	.	+	+	.	+	+	.	+	.	.	+	+	+	.	.	.	+	.	.	.	.	.	.	.	+	+	.	.	.	+	.	.	.	1	.	.	.	+	1	.	1
Commiphora mollis	.	.	.	.	+	+	.	a	.	.	.	.	.	.	+	.	+	+	.	+	.	+	+	.	.	.	.	.	.	.	.	.	.	1	+	+	.	1	+	1	+	+	.	.	.	.
Enneapogon scoparius	.	.	.	.	.	+	1	1	+	.	.	.	.	.	.	.	1	1	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	+	+	+	.	+	+	+	.	+
Grewia flava	.	.	.	.	+	.	+	.	.	.	.	.	+	+	.	.	1	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	+	.	.	+	+	.	.	+	.	+
Berchemia zeyheri	.	.	.	.	+	+	.	.	.	.	.	.	.	+	+	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	1	+	.	.	1	.	1	+	.

* Alien species

7.3 Description of plant communities

All the species and species groups that will be referred to are included in Table 7.1. The values given for anthropogenic influences, such as bush thickening and disturbance and the values given for the description of the physiognomy are averages for the community or sub-community being discussed. Some species were only recorded once or a few times with a low cover abundance or they were not confined to a specific species group. These species were not included in Table 7.1, but they are given in Table 7.4 at the end of this Chapter.

The particle size distribution will be given for each of the communities and considerable variations in other soil characteristics will be mentioned. Other environmental factors, such as aspect, slope, topography and percentage rocks on the soil surface played a more important role in distinguishing between communities in this land type than soil characteristics. They will therefore be the focus in the discussion of the communities.

1. *Monsonia angustifolia* - *Combretum apiculatum* Community

The *Monsonia angustifolia* - *Combretum apiculatum* Community was found on sandy loam soil on northern midslopes and plateaus of the Dwarsberg and the mountain at Ramosibitswana (Figure 7.2). The survey sites were located on the farms Rampapaanspoort, Welverdiend and Droogesloot. Particle distribution for particles smaller than 2 mm was: sand = 58.5 %, silt = 25.5 % and clay = 16 %. Particles larger than 2 mm made up 14.2 % of the soil. There was more bush thickening (35 %) in this community than in the other communities. This was however not very high compared to bush thickening in the other land types. The average slope in this community was 28°. Some overgrazing was recorded, but no compaction or erosion were visible.

The diagnostic species for this community can be found in species group A and they include the annual herbs *Monsonia angustifolia* and *Crotalaria sphaerocarpa*, the tree *Acacia tortilis* and the annual herb *Nidorella resedifolia* subsp. *resedifolia*. This community was further typified by the absence of species groups L and S. The dominant species in this community were the perennial grass *Aristida canescens*, the trees *Dichrostachys cinerea*, *Sclerocarya birrea* (species group T) and *Combretum apiculatum* (species group Q) and the perennial grass *Chrysopogon serrulatus* (species group M). An average of 37 species was found per relevé, which was the lowest of all the communities. The percentage alien species, namely 6.5 % was the highest of all the communities. This is an indication that this community was more disturbed than the other communities. Two protected tree species was found in this community: *Sclerocarya birrea* was found in most of the relevés and *Boscia albitrunca* (Department of Water Affairs and Forestry, 2007) was found once in this community.

Figure 7.2 The *Monsonia angustifolia* - *Combretum apiculatum* Community (Community 1) of the Fb land type. GPS reading: lat 24°57’41.1”S, long 26°43’52.4”E.

The grass stratum was well developed with a cover of 53 % and 0.4 m tall. The tree stratum had a cover of 27 %, with a height of 3.5 m. The shrub stratum had a cover of 14 % and was 1.3 m high. The forb stratum had a cover of 11 % and it was 0.3 m tall.

2. *Sphedamnocarpus pruriens* - *Terminalia sericea* Community

This community was found on leached sandy soil. It was unique, because of its location, slope and northern aspect (Figure 7.3). The *Sphedamnocarpus pruriens* - *Terminalia sericea* Community was found not far north of the summit of the Dwarsberg, on the farm Rampapaanspoort. This community is however most likely also found east of where it was sampled, namely along the extent of the Dwarsberg, which was highly inaccessible. The slope was not as steep as in the other communities, which resulted in the soil being deeper in some parts, as the soil is not so easily washed away by rain water. Four relevés were done in this community, two of them were in Mispah soil, but the other two were on the Hutton and Glenrosa soil forms. These soil were deeper and consisted of an A-horizon as well as a B-horizon, whereas the Mispah soil form consists of an ortic A-horizon on hard rock. The soil sample analysed for this community had a low magnesium and potassium concentration (respectively 74 mg/kg and 35 mg/kg) and in general the base status was low (also see Figure 7.11). Particle distribution for particles smaller than 2 mm was: sand = 91.5 %, silt = 0.7 % and clay = 7.8 %. Particles larger than 2 mm made up 0.1 % of the soil. The average soil depth for this community was 50 cm, which was considerably deeper than those of the other communities. The average percentage rocks on the soil surface was also drastically lower than those of the other communities. It was 5.5 %, whereas the average for the other communities in the Fb land type was 63 %. Very little disturbance was recorded in this community. This community can be seen on the aerial photographs, as it formed a lighter strip across the Dwarsberg (Figure 7.4).

Figure 7.3 The *Sphedamnocarpus pruriens* - *Terminalia sericea* Community (Community 2) of the Fb land type. GPS reading: lat 24°58'09.0"S, long 26°41'19.8"E. Note the even slope and the dominant *Terminalia sericea* trees.

The diagnostic species for this community can be found in species group B and they include the shrub or climber *Sphedamnocarpus pruriens*, the perennial herbs *Chamaecrista biensis* and *Hypoestes forskaolii* and the perennial grass *Schmidtia pappophoroides.* This community could further be characterised by the absence of the species in species groups A, K, N and P. The dominant species for this community included the tree *Terminalia sericea* and the perennial grasses *Digitaria eriantha*, *Pogonarthria squarrosa* (species group L) and *Heteropogon contortus* (species group M). An average of 52 species was recorded per relevé and 5.4 % of all the species recorded in this community were aliens. The protected tree species *Sclerocarya birrea* (Department of Water Affairs and Forestry, 2007) was found once in this community.

The grass and tree strata had covers of 38 % and 31 % and heights of 0.5 m and 3.3 m respectively. The forb and shrub strata had covers of 11 % and 8 % and heights of 0.4 m and 0.9 m respectively.

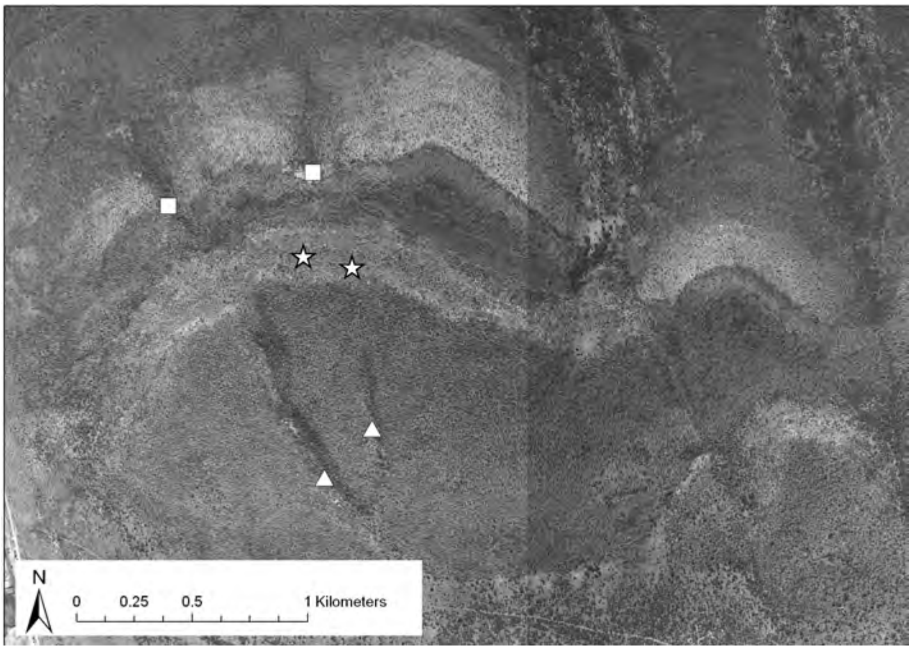

Figure 7.4 An aerial photograph of a part of the Dwarsberg. The two stars in the lighter strip shows the position of the two survey sites in the *Sphedamnocarpus pruriens* - *Terminalia sericea* Community (Community 2). GPS reading of survey sites: lat 24°58'10"S, long 26°41'14" - 26°41'29" E. The vegetation was clearly different from the surrounding communities. The ravines can also be seen: the *Abutilon ramosum* - *Pappea capensis* Sub-community (Sub-community 7.2) on the northern slope is indicated by the squares and the *Enneapogon cenchroides* - *Peltophorum africanum* Community (Community 3) on the southern slope is indicated by the triangles.

A somewhat similar vegetation unit was described by Zacharias (1994) namely the *Terminalia sericea* veld that was found on well drained sandy soil in the north-western corner of Madikwe Game Reserve.

3. *Enneapogon cenchroides* - *Peltophorum africanum* Community

The *Enneapogon cenchroides* - *Peltophorum africanum* Community was found on sandy loam soil on southern midslopes and escarpments of the Dwarsberg in ravines, with an average slope of 23° (Figure 7.5). It was found on the farm Rampapaanspoort. Particle distribution for particles smaller than 2 mm was: sand = 74 %, silt = 12.8 % and clay = 13.2 %. Particles larger than 2 mm made up 3.9 % of the soil. Some overgrazing was noted.

The diagnostic species for this community included the annual grass *Enneapogon cenchroides*, the perennial herb *Cleome oxyphylla* var. *oxyphylla*, the perennial grass *Eustachys paspaloides* and the perennial sedge *Cyperus fulgens* (species group C). The following species were dominant in this community: the perennial grasses *Panicum maximum* (species group U) and *Digitaria eriantha* (species group L) and the trees *Peltophorum africanum* (species group T), *Combretum molle* (species group T) and *Combretum zeyheri* (species group L). An average of 61 species per relevé was recorded in the *Enneapogon cenchroides* - *Peltophorum africanum* Community and 5.1 % of the species in this community were aliens. The protected tree species

Sclerocarya birrea (Department of Water Affairs and Forestry, 2007) was found once in this community.

Figure 7.5 The *Enneapogon cenchroides* - *Peltophorum africanum* Community (Community 3) of the Fb land type. GPS reading: lat 24°58'35.9"S, long 26°41'27.9"E. This community was found in ravines on the southern slope of the Dwarsberg.

The grass and tree strata dominated, with covers of 49 % and 48 % respectively. The grass stratum was 0.4 m high and the tree stratum was 4.5 m high. The forb and shrub strata had covers of 23 % and 8 % and heights of 0.4 m and 1 m respectively. This community, together with Sub-community 7.2 had a remarkable high percentage cover for especially the tree stratum, but also for the other strata, as they were both found in ravines.

4. *Acacia mellifera* - *Bridelia mollis* Community

The *Acacia mellifera* - *Bridelia mollis* Community was found in sandy soil. It was under-sampled as only three relevés were included. Two of these relevés were done on the hill Tshweneng on the farm Vogelstuiskraal, which was much smaller than Dwarsberg. These relevés were done on western midslopes, which was most likely one of the major reasons why the vegetation was different from the other communities. Tshweneng was very rocky (73 % rockiness on the soil surface), with little disturbance. The third relevé was done on the southern midslope of the Dwarsberg where the slope was more even than above and below it. It seems as if there might have been a small village very long ago. The remains of an ancient kraal were found and this relevé was more disturbed with some overgrazing and compaction. Rockiness at this relevé was only 30%.

Potassium concentration in this community is low (75.5 mg/kg). Particle distribution for particles smaller than 2 mm was: sand = 82 %, silt = 8.2 % and clay = 9.8 %. Particles larger than 2 mm made up 1.9 % of the soil.

The diagnostic species for this community can be found in species group D and they include the tree *Acacia mellifera*, the perennial herbs *Tephrosia elongata* and *Senecio harveianus* and the annual herbs *Vernonia poskeana*, *Sida cordifolia* and *Sida spinosa*. The dominant species in the *Acacia mellifera* - *Bridelia mollis* Community were the tree *Bridelia mollis*, the shrub *Grewia monticola* (species group T) and the perennial grass *Digitaria eriantha* (species group L). This community had the highest species diversity of all the communities of the Fb land type (average 62 species per relevé), which can be attributed mostly to the high species diversity at Tweneng. It also had the lowest percentage alien species of all the communities in the Fb land type. Of all the species recorded in this community only 2.5 % were aliens. In this light, further studies on Tweneng are important and will yield valuable results in terms of biodiversity. The protected tree species *Boscia albitrunca, Sclerocarya birrea* and *Elaeodendron transvaalensis* (Department of Water Affairs and Forestry, 2007) and the red data species *Boophone disticha* (South African National Biodiversity Institute, 2009), that falls into the 'Declining' category, were found in this community.

The cover of the tree layer was quite high for the relevés in Tweneng, but low for the other relevé. The tree stratum was well developed in this community with a cover of 42 % and a height of 4 m. The grass stratum had a cover of 32 % and it was 0.7 m tall. The forb stratum had a cover of 20 % and a height of 0.5 m and the shrub stratum had a cover of 18 % and it was 1.1 m tall.

5. *Blepharis maderaspatensis* - *Croton gratissimus* Community

The *Blepharis maderaspatensis* - *Croton gratissimus* Community was found on steep northern midslopes, with an average slope is 40°, which was the steepest of all the communities (Figure 7.6). It was located on Dwarsberg and the mountain at Ramosibitswana on the farms Vogelstruisdraai and Kameelboom. The percentage rockiness on the soil surface was 69 %, which is very high and bush thickening was 14 %. No soil analyses were carried out for this community, as no representative soil samples were collected.

The diagnostic species for this community were the perennial herbs *Blepharis maderaspatensis* and *Ipomoea obscura* (species group E). It could further be characterised by the absence of species group L. The tree *Croton gratissimus* (species group S), the annual grass *Melinis repens*, the annual herb *Waltheria indica* (species group L) and the tree *Combretum molle* (species group T) were the dominant species in this community. An average of 55 species per relevé was recorded in the *Blepharis maderaspatensis* - *Croton gratissimus* Community and 4.3 % of the species in this community were aliens. Two protected tree species according to the Department of Water Affairs and Forestry (2007) was found in this community, namely *Boscia albitrunca* and *Sclerocarya birrea.*

Figure 7.6 The *Blepharis maderaspatensis* - *Croton gratissimus* Community (Community 5) of the Fb land type. GPS reading: lat 24°58'47.8"S, long 26°57'34.7"E. This community was found on very steep slopes. Note the *Combretum* species and the high percentage rockiness on the soil surface.

In this community the tree stratum formed the dominant stratum with a cover of 28 % and it was 2.9 m tall. The grass stratum had a cover of 25 %, the forb stratum of 21 % and the shrub stratum of 15 %. The grass and forb stratums had a height of 0.4 m and the shrub stratum was 1.2 m tall.

A somewhat similar community was described by Brown (1997), namely the *Schkuhria pinnata* – *Combretum zeyheri* woodland, which was located on northern midslopes on sandy to loamy soil.

6. *Bulbostylis hispidula* var. *pyriformis* - *Combretum zeyheri* Community

This community was found on sandy soil on southern midslopes and plateaus (Figure 7.7). The average slope was 21° and 60 - 80 % of the soil surface was covered with rocks (average 68 %). Magnesium and potassium concentrations were low (respectively 39.9 mg/kg and 19 mg/kg). Particle distribution for particles smaller than 2 mm was: sand = 84.8 %, silt = 6.3 %

and clay = 8.9 %. Particles larger than 2 mm made up 8.1 % of the soil. Some sheet erosion and overgrazing were recorded.

Figure 7.7 The *Bulbostylis hispidula* var. *pyriformis* - *Combretum zeyheri* Community (Community 6) of the Fb land type. GPS reading: lat 24°58'14.6"S, long 26°57'18.1"E.

The diagnostic species for this community were found in species group G and they included the annual sedge *Bulbostylis hispidula* var. *pyriformis*, the perennial grass *Aristida meridionalis*, the shrub *Indigofera comosa* and the perennial herb *Hermannia tomentosa*. This community was further characterised by the absence of the species in species groups F and N. Dominant species in this community included the trees *Combretum zeyheri* (species group L) and *Combretum molle* (species group T), the perennial grass *Digitaria eriantha* and the tree *Burkea africana* (species group L). An average of 56 species per relevé was recorded and a mere 3 % of the species in this community were aliens.

The tree and grass strata formed the dominant strata in the *Bulbostylis hispidula* var. *pyriformis* - *Combretum zeyheri* Community. The tree stratum had a cover of 35 % and it was 4.2 m in height. The grass, forb and shrub strata had covers of 33 %, 16 % and 8 % and heights of 0.6 m, 0.3 m and 1.1 m respectively.

Two sub-communities were identified in the *Bulbostylis hispidula* var. *pyriformis* - *Combretum zeyheri* Community.

6.1 *Gomphocarpus fruticosus - Combretum molle* Sub-community

This sub-community was located on the southern slopes of the Dwarsberg. The *Gomphocarpus fruticosus* - *Combretum molle* Sub-community was found on rockier soil than the *Eragrostis biflora* - *Burkea africana* Sub-community. Percentage rocks on the soil surface was 73 % and clay percentage was slightly lower in Sub-community 6.1 than in Sub-community 6.2. Particle distribution for particles smaller than 2 mm was: sand = 86.9 %, silt = 6.2 % and clay = 6.9 %. Particles larger than 2 mm made up 4.4 % of the soil. There was little disturbance in both sub-communities, but a bit more in Sub-community 6.1.

The diagnostic species included the perennial herbs *Gomphocarpus fruticosus* and *Xerophyta retinervis,* the perennial grass *Schizachyrium jeffreysii*, the annual herb *Leucas martinicensis* and the perennial herb *Indigofera filipes* (species group H). This sub-community can also be characterised by the absence of the species from species group J. The dominant species in this sub-community included the tree *Combretum zeyheri* (species group L), the perennial grass *Aristida meridionalis* (species group G), the tree *Combretum molle* (species group T) and the annual herb *Oldenlandia herbacea* (species group L). An average of 50 species was recorded per relevé and 3.6 % of all the species recorded in this community were aliens. One protected tree species, namely *Sclerocarya birrea* (Department of Water Affairs and Forestry, 2007) was found in this community.

There was not a noticeable difference between the physiognomy of the two sub-communities.

6.2 *Eragrostis biflora - Burkea africana* Sub-community

This sub-community was found on southern slopes of the mountain at Ramosibitswana. The average percentage rocks on the soil surface was lower, namely 61 %, in this sub-community than in Sub-community 6.1. Particle distribution for particles smaller than 2 mm was: sand = 82.8 %, silt = 6.4 % and clay = 10.8 %. Particles larger than 2 mm made up 11.8 % of the soil.

The diagnostic species of the *Eragrostis biflora* - *Burkea africana* Sub-community included the perennial grass *Eragrostis biflora*, the shrub or tree *Ochna pulchra*, the perennial climber *Pentarrhinum insipidum* and the shrubs *Strychnos madagascariensis* and *Cryptolepis oblongifolia* (species group J). This sub-community was further characterised by the absence of species group H. Dominant species included the trees *Combretum zeyheri* and *Burkea africana* (species group L), the annual herb *Waltheria indica* (species group L), the tree *Combretum molle* (species group T) and the perennial grass *Digitaria eriantha* (species group L). This sub-community had the highest species diversity of all the communities and sub-communities in this land type. An average of 63 species per relevé was recorded and 3.8 % of the species in this community were aliens.

Communities 1 to 6 was somewhat similar to the *Acacia caffra – Crysopogon montanus* savanna described by Coetzee (1972) which was located on north facing dolomite koppies on the Jack Scott-Nature Reserve.

7. *Spirostachys africana - Panicum maximum* Community

The *Spirostachys africana - Panicum maximum* Community was found mostly on northern midslopes, escarpments and plateaus with an average slope of 30° (Figure 7.8). It had a high percentage rocks on the soil surface, namely 71 % and was found on the farms Rampapaanspoort and Kameelboom. Particle distribution for particles smaller than 2 mm was: sand = 64.5 %, silt = 18.3 % and clay = 17.1 %. Particles larger than 2 mm made up 12.6 % of the soil. There was very little disturbance, with bush thickening only 16 %.

Figure 7.8 The *Spirostachys africana - Panicum maximum* Community (Community 7) of the Fb land type. GPS reading: lat 24°58'47.3"S, long 26°57'26.7"E. As can be seen on the photo, this community was very dense.

The diagnostic species for this community were found in species group N and they included the tree *Spirostachys africana*, the perennial grass *Enteropogon macrostachyus*, the tree *Pappea capensis*, the annual herb *Pupalia lappacea* and the shrub *Grewia bicolor.* It was further characterised by the absence of the species in species group M. The following species were the dominant species in this community: the tree *Spirostachys africana* (species group N), the perennial grasses *Enteropogon macrostachyus* (species group N) and *Panicum maximum* (species group T) and the tree *Dichrostachys cinerea* (species group T). An average of 46 species was recorded per relevé and only 3 % of the species were aliens. Two protected tree species were found in Community 7, namely *Boscia albitrunca* and *Securidaca longepedunculata.*

The tree stratum was very well developed in this community, with a cover of 62 % and a height of 5.2 m. Both the cover and the height of the tree stratum were the highest of all the communities in the Fb land type. The grass stratum had a cover of 34 %, the forb stratum of 26 % and the shrub stratum of 27 %. The grass, forb and shrub stratums were 0.5 m, 0.6 m and 1.4 m tall respectively.

A similar community was described by Brown (1997), namely the *Pappea capensis* – *Spirostachys africana* mountain woodland, which was found on north-eastern midslopes of the Mogosane Mountain in the Borakalalo Nature Reserve.

Two sub-communities could be distinguished in this community.

7.1 *Pouzolzia mixta* - *Croton gratissimus* Sub-community

The *Pouzolzia mixta* - *Croton gratissimus* Sub-community was found on sandy soil on much steeper midslopes (34˚) than the *Abutilon ramosum* - *Pappea capensis* Sub-community. Of all the communities in this land type, only Community 4 was found on steeper slopes. Three of the sites were found on northern slopes and two on southern slopes. The potassium concentration of the soil was low (68.3 mg/kg). Particle distribution for particles smaller than 2 mm was: sand = 84.4 %, silt = 7 % and clay = 8.6 %. Particles larger than 2 mm made up 9.6 % of the soil.

The diagnostic species fell into species group O and include the shrub or tree *Pouzolzia mixta*, the annual herb *Pavonia senegalensis*, the perennial geophyte *Sansevieria aethiopica* and the shrub *Gymnosporia heterophylla.* This sub-community was also characterised by the absence of the species of species group S. The dominant species for this sub-community included the trees *Croton gratissimus* (species group S) and *Spirostachys africana* (species group N) and the shrub *Psiadia punctulata* (species group P). An average of 45 species per relevé was recorded in the *Pouzolzia mixta* - *Croton gratissimus* Sub-community and 4.2 % of the species found in this community were aliens.

The tree stratum formed the dominant stratum with a cover of 56 % and a height of 4.2 m. The grass stratum had a cover of 28 % and it was 0.5 m in height. The forb stratum had a cover of 19 % and a height of 0.5 m and the shrub stratum had a cover of 17 % and it was of 1.3 m tall.

7.2 *Abutilon ramosum* - *Pappea capensis* Sub-community

This sub-community was mostly found in ravines on the northern midslopes, escarpments and plateaus of the Dwarsberg on clay loam soil. The slope (average 25°) was not as steep as those of Sub-community 7.1. A soil sample taken in this sub-community at site 110 were analyzed and it had a very high electrical conductivity (264 mS/m). This was because of a very high potassium concentration in the soil. The cations for this community were unusually high, the reason for this was not known. Concentration were: calcium = 4223 mg/kg; magnesium = 694.5 mg/kg; potassium = 562.5 mg/kg and phosphorus = 123 mg/kg. Particle distribution for particles smaller than 2 mm was: sand = 44.7 %, silt = 29.7 % and clay = 25.7 %. Particles larger than 2 mm made up 15.7 % of the soil.

The diagnostic species for the *Abutilon ramosum* - *Pappea capensis* Sub-community included the shrubs *Abutilon angulatum*, *Abutilon ramosum* and *Acalypa glabrata* var. *pilosa*, the tree *Acacia karroo* and the shrub *Boscia foetida* (species group R). This sub-community was also characterised by the absence of species groups O, P and Q. The dominant species for this sub-community were the tree *Spirostachys africana* (species group N), the perennial grasses *Panicum maximum* (species group T) and *Enteropogon macrostachyus* and the tree *Pappea capensis* (species group N). An average of 47 species was recorded per relevé and only 3 % of all the species recorded in this community were aliens.

All the strata in this sub-community had a very high cover compared to the other communities and sub-communities. The tree stratum formed the dominant stratum with a cover of 67 % and a height of 6.1 m. The grass, shrub and forb stratums had a cover of 39 %, 36 % and 32 % respectively, while their height was 0.4 m, 1.5 m and 0.7 m respectively.

7.4 Ordinations

Correspondence Analysis (CA) and Principal Component Analysis (PCA) ordinations were carried out to determine the correlations between the species data and the environmental data of the sample plots in the different plant communities. A CA ordination was carried out for all seven communities (Figure 7.8). Once again it is important to keep in mind that a CA is an indirect ordination and that the distribution of the relevés in the ordination is entirely based on species composition. Some environmental variables were overlain to help identify correlations between species data and environmental data. In the first ordination it may however cause confusion because of the great number of plant communities and heterogeneity of the relevés.

A CA ordination was carried out including all the environmental data. This ordination showed that no positive correlations could be found with most of the environmental variables and were therefore not considered to distinguish between the different communities. The soil form in all the seven communities was also the same, namely Mispah, with the exception of only two sites. These soil were very shallow with a low clay percentage. Even though there was some variation in soil dept and clay percentage between the different communities, no distinct correlation coefficients could be found. Topography was the main characteristic that contributed to the difference in the communities. Only one quantitative variable, namely slope and two nominal variables, namely ‘North’ and ‘South’ (northern and southern aspects) were included to characterise the difference between the communities. Even these three variables did not show very strong correlations with the axis in the first ordination (Figure 7.9).

Nominal variables do not indicate any gradients on the axes, but were still useful in these ordinations (Figure 7.9). Slope had a correlation coefficient of 0.33 for ordination axis 1 and 0.37 for ordination axis 2. From this it can be concluded that Community 7 had a slight positive correlation with steeper slopes and that Communities 1 and 7 were mostly found on northern slopes. The aspect ‘North’ was positively correlated with both axes, with correlation coefficients of 0.49 for the first ordination axis and 0.41 for the second ordination axis. Communities 3 and 6 were found on the southern slopes with negative correlation coefficients of -0.47 for the first axis and -0.46 for the second axis respectively. In Figure 7.9 it can be seen that Communities 1 and 7 are the most dissimilar from the other communities based on species composition.

Another CA ordination was carried out including only Communities 3, 4 and 5 (Figure 7.10) as they were not clearly distinguished from one another in the first ordination (Figure 7.9). Slope was strongly correlated with the first ordination axis (0.86) (Table 7.3), indicating that Community 5 was mainly found on steeper slopes, whereas Community 3 was found on more even slopes. Percentage rocks on the soil surface formed a strong negative correlation with ordination axis 2, with a correlation coefficient of -0.74. Community 5 was found on northern slopes with a higher percentage rocks on the soil surface, whereas Community 3 occurred on southern slopes. The northern aspect had a more positive correlation with the first ordination axis (0.77) and the southern aspect had a more negative correlation with the first ordination axis (-0.81) (Table 7.3).

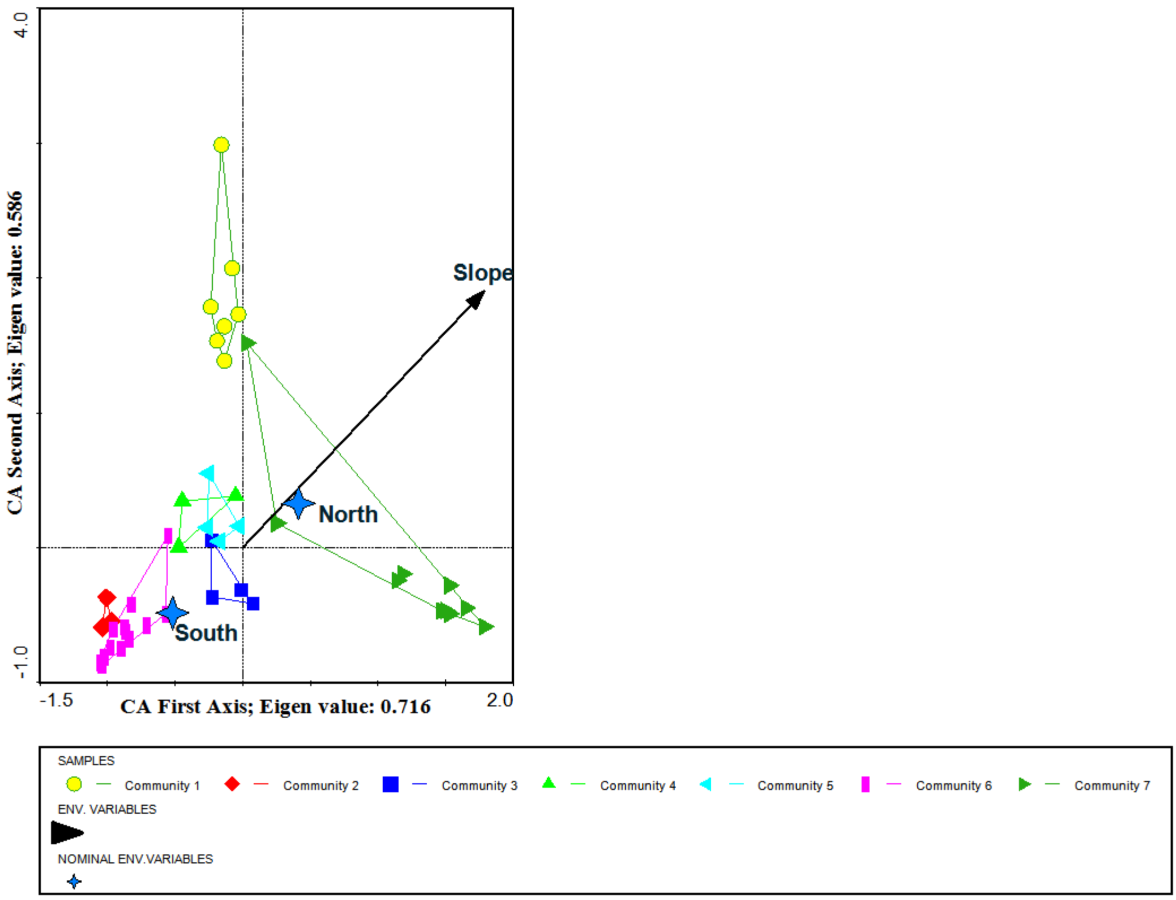

Figure 7.9 CA ordination biplot with environmental variables and samples/relevés of all the communities (1 to 7) of the Fb land type. The following communities are shown in this ordination: the *Monsonia angustifolia* - *Combretum apiculatum* Community (1), the *Sphedamnocarpus pruriens* - *Terminalia sericea* Community (2), the *Enneapogon cenchroides* - *Peltophorum africanum* Community (3), the *Acacia mellifera* - *Bridelia mollis* Community (4), the *Blepharis maderaspatensis* - *Croton gratissimus* Community (5), the *Bulbostylis hispidula* var. *pyriformis* - *Combretum zeyheri* Community (6) and the *Spirostachys africana* - *Panicum maximum* Community (7).

Table 7.2 Correlation coefficients of environmental factors of Figure 7.9.

Environmental Factor	**Ordination Axis 1**	**Ordination Axis 2**
Slope	0.3308	0.3704
North	0.4862	0.4070
South	-0.4667	-0.4577

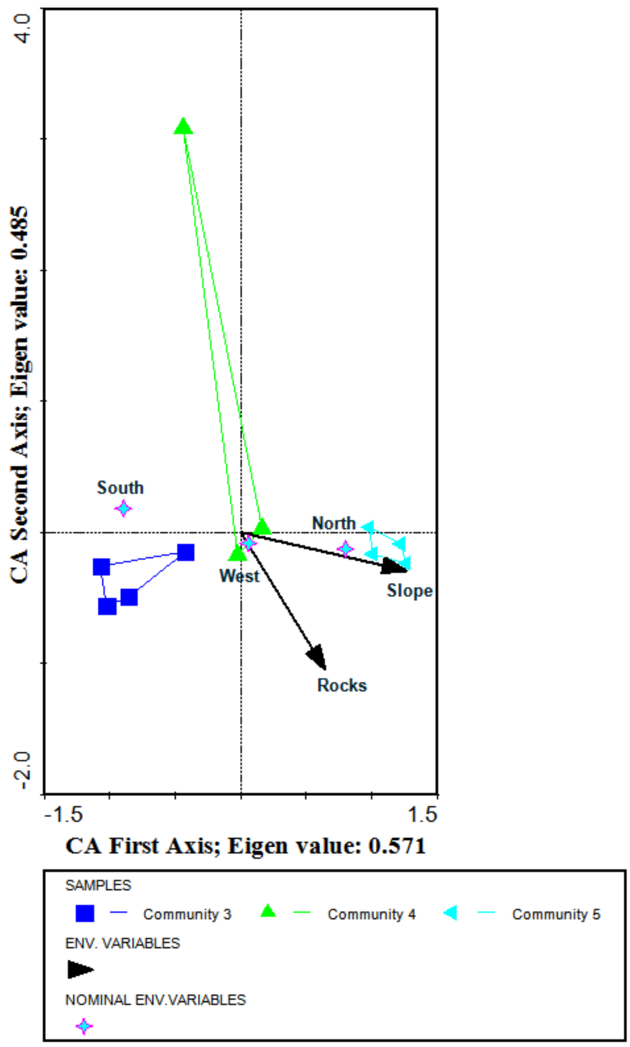

Figure 7.10 CA ordination biplot of Communities 3 to 5 of the Fb land type, the *Enneapogon cenchroides* - *Peltophorum africanum* Community (3), the *Acacia mellifera* - *Bridelia mollis* Community (4) and the *Blepharis maderaspatensis* - *Croton gratissimus* Community (5), showing environmental variables and samples/relevés.

Table 7.3 Correlation coefficients of environmental factors of Figure 7.10.

Environmental Factor	Ordination Axis 1	Ordination Axis 2
Slope	0.8599	-0.2073
Rocks	0.4401	-0.7425
North	0.7667	-0.1261
South	-0.8057	0.1704
West	-0.0582	0.0987

The vegetation of this land type was very heterogeneous and inaccessible as it is found on mountains which could often only be accessed by foot. Many of the communities were therefore under-sampled.

The PCA ordination (Figure 7.11) of the soil analyses shows that the soil of Sub-community 7.2 was very unique, if compared to the other communities, due to the higher clay content. This sub-community also had a higher concentration of phosphorus, higher electrical conductivity (EC) and cation exchange capacity (CEC), which affected the species composition (see description of Sub-community 7.2). According to this ordination it is also clear that Communities 2 and 6 were mostly found in sandier soil.

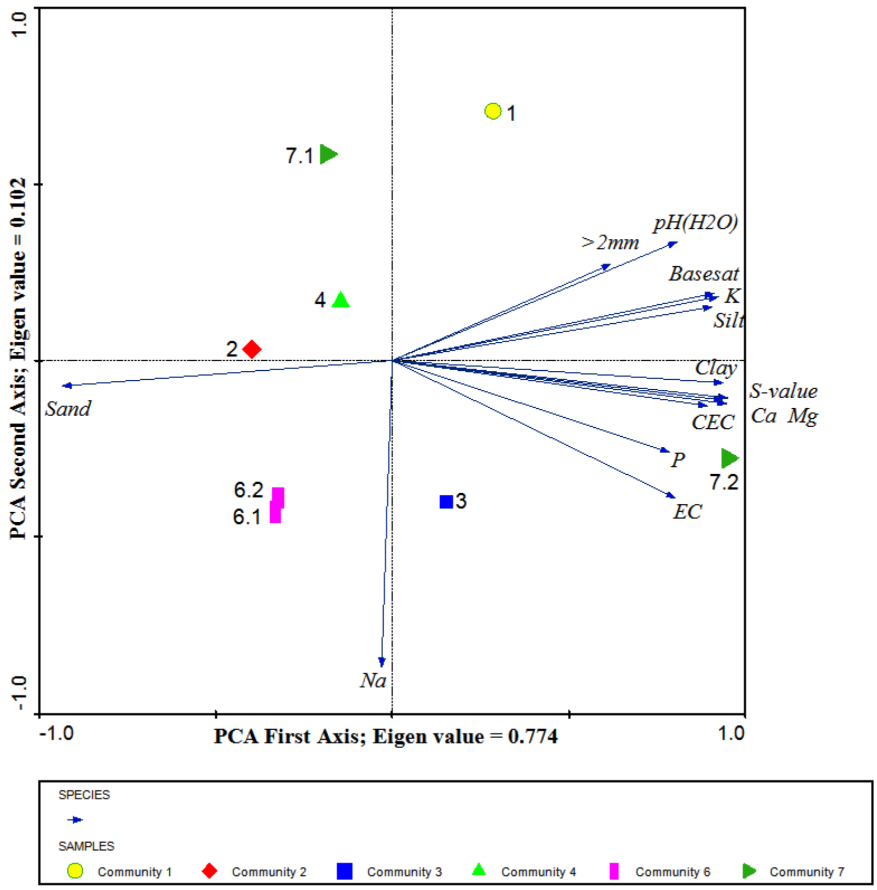

Figure 7.11 PCA ordination biplot of the data from the soil analysis in the different communities and sub-communities. The following communities are shown in this ordination: the *Monsonia angustifolia* - *Combretum apiculatum* Community (1), the *Sphedamnocarpus pruriens* - *Terminalia sericea* Community (2), the *Enneapogon cenchroides* - *Peltophorum africanum* Community (3), the *Acacia mellifera* - *Bridelia mollis* Community (4), the *Blepharis maderaspatensis* - *Croton gratissimus* Community (5), the *Bulbostylis hispidula* var. *pyriformis* - *Combretum zeyheri* Community (6): the *Gomphocarpus fruticosus* - *Combretum molle* Sub-community (6.1), the *Eragrostis biflora* - *Burkea africana* Sub-community (6.2), the *Spirostachys africana* - *Panicum maximum* Community (7): the *Pouzolzia mixta* - *Croton gratissimus* Sub-community (7.1) and the *Abutilon ramosum* - *Pappea capensis* Sub-community (7.2).

7.5 Soil and distribution of relevé pairs

In the Fb land type 44 out of the 46 relevés were found on Mispah soil which are shallow and have a low clay percentage. Soil depth and clay percentage did not have such a great influence on the communities.

As mentioned in Chapter 3, two relevés were completed at each site. Some of these relevé pairs in the Fb land type did not fall into the same community, because the 200 m transect was done up the slope and communities sometimes change as one move up the slope. The first relevé of site 59 was done on the northern slope and the second relevé on the southern slope, as the crest of the mountain was lower than expected and the transect went down on the opposite slope. The relevés of site 63 also fell into different communities as the second relevé was more disturbed and the slope was more even. In sites 96 and 97 the first relevés fell into Sub-community 7.1 and the second relevés fell into Community 5. Two of these sites were done to solve the problem.

7.6 Species composition

In the Fb land type 97 % of the recorded species are indigenous and 78 % are perennial. Most of the alien species (80 %) are annual and therefore they don't pose a serious threat to indigenous vegetation. Only two of the alien species are perennial. The most common growth form is herbs and then shrubs (Figure 7.12). The average species richness is 51 species per relevé, which is the highest of all the land types.

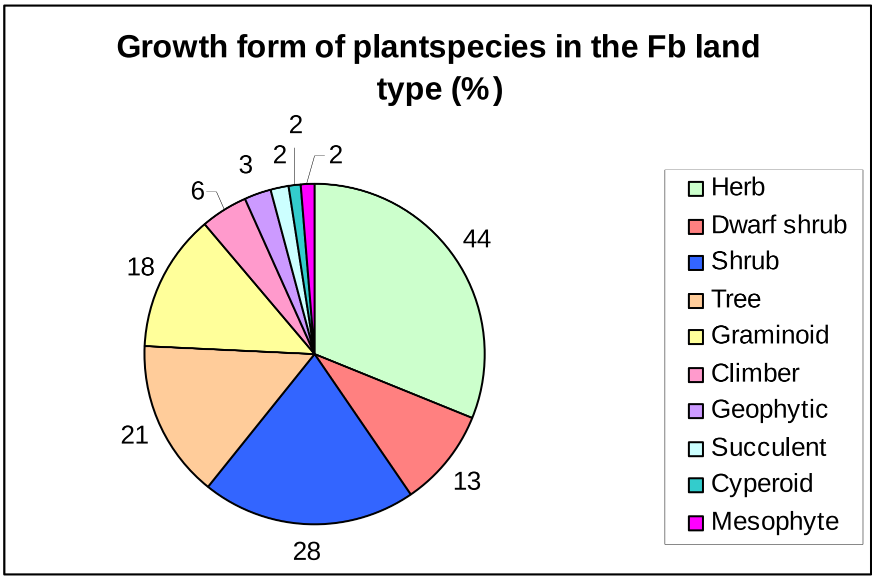

Figure 7.12 Composition of the different growth forms of the species in the Fb land type.

7.7 Conclusion

The Fb land type in the Central Corridor Area (CCA) fell into the Dwarsberg-Swartruggens Mountain Bushveld vegetation type as described by Mucina & Rutherford (2006), which is very heterogeneous and is found on mountains. Seven communities and four sub-communities were identified and described in the Fb land type in the CCA. From the ordinations and the averages of the environmental data it could be concluded that there was a clear difference between the communities found on northern slopes and those found on southern slopes. Some of the communities had unique locations, which distinguish them from other communities. Examples are the *Sphedamnocarpus pruriens* - *Terminalia sericea* Community (Community 2), found not far north of the crest of the Dwarsberg, and the *Enneapogon cenchroides* - *Peltophorum africanum* Community (Community 3) and Sub-community 7.2 which were found in ravines. Communities 1, 2, 5 and 7 were found on northern slopes, Communities 3 and 6 were found on southern slopes and Community 4 on western slopes. Communities 1, 5 and 7 were found on steeper slopes than the other communities. Four protected tree species namely *Boscia albitrunca, Elaeodendron transvaalensis, Sclerocarya birrea* and *Securidaca longepedunculata* and one red data species in the 'Declining' category: *Boophone disticha* were found in the Fb land type. Some similar communities were described by other authors. A community that was somewhat similar to Communities 1 to 6 were identified by Coetzee (1972) in the Jack Scott Nature Reserve. Zacharias described a community in Madikwe Game Reserve that was somewhat similar to Community 2. Brown (1997) described one community that was somewhat similar to the *Blepharis maderaspatensis* - *Croton gratissimus* Community (Community 5) and another community that was similar to the *Spirostachys africana* - *Panicum maximum* Community (Community 7). The Fb land type was under-sampled, due to its great diversity and inaccessibility caused by the rugged terrain. Roads in this land type were also limited. Future studies should be carried out in this land type as it should yield valuable results in terms of species diversity.

Table 7.4 List of species for the Fb land type which are not shown in Table 7.1, because they occurred only once or a few times with a low cover abundance or they were not confined to specific communities.

Community	Species (relevé number)(cover abundance value)
1.	*Anthephora pubescens* (112)(+), (113)(+); *Boerhavia diffusa* (112)(+); **Chenopodium carinatum* (154)(+); *Cucumis zeyheri* (138)(+); *Dicoma tomentosa* (112)(1); *Hibiscus pusillus* (112)(+); *Indigofera charliriana* var. *charliriana* (146)(+); *Panicum coloratum* (138)(+); *Polygala hottentotta* (112)(+)
2.	*Digitaria monodactyla* (167)(+); *Hirpicium bechuanense* (166)(+); *Indigofera alternans* (167)(+); *Striga asiatica* (167)(+); *Vernonia oligocephala* (167)(+)
3.	*Aerva leucura* (157)(+); **Chenopodium album* (157)(1); *Commiphora africana* (162)(+); *Cussonia paniculata* (163)(+); *Cyperus* species (157)(+); *Ficus abutilifolia* (156)(+); *Indigofera laxeracemos* (156)(+); *Kohautia virgata* (157)(+); *Nenax* species (157)(+); *Raphionacme velutina* (156)(+); *Rhoicissus tridentata* (162)(+), (163)(+); *Scadoxus puniceus* (162)(+); *Scolopia zeyheri* (163)(+); *Thesium* species (162)(+)
4.	*Boophone disticha* (97)(+); *Cleome monophylla* (97)(+); *Ehretia amoena* (96)(+); *Elaeodendron transvaalense* (96)(+); *Eragrostis nindensis* (125)(+); *Eragrostis viscosa* (125)(+); *Lannea schweinfurthii* (96)(+); *Leonotis ocymifolia* var. *schinzii* (97)(+); *Oropetium capense* (125)(+); *Rhus lancea* (96)(+); *Tarchonanthus camphoratus* (96)(+)
5.	*Aristida junciformis* (222)(+); *Barleria repens* (221)(+); *Cheilanthes viridis* (222)(+); *Heliotropium strigosum* (221)(+); *Kalanchoe thyrsiflora* (193)(+); *Portulaca kermesina* (191)(+); *Rhynchosia* species (191)(+); *Tylophora flanaganii* (191)(+)
6.	*Eragrostis gummiflua* (64)(+), (65)(+), (109)(1); *Sida dregei* (65)(+), (189)(+)
6.1	*Brachiaria eruciformis* (64)(+); *Cleome maculata* (121)(+), (132)(+); *Corchorus kirkii* (64)(+); *Crassula lanceolata* subsp. *transvaalensis* (117)(+); *Dicliptera eenii* (64)(+), (65)(+); *Dicoma anomala* (117)(+); *Kalanchoe lanceolata* (117)(+); *Ledebouria revoluta* (64)(+); *Lippia rehmannii* (121)(+); *Pseudognaphalium undulatum* (120)(+); *Sida ovata* (65)(+); *Viscum capense* (132)(+); *Viscum combreticola* (132)(+), (133)(+)
6.2	*Conyza* species (107)(+); *Crabbea angustifolia* (188)(+); *Crotalaria lotoides* (194)(+), (195)(+); *Cymbopogon pospischilii* (107)(+); *Cyperus rupestris* (194)(+); *Dichanthium annulatum* (109)(+); *Gladiolus permeabilis* (188)(+), (194)(+); *Gnidia kraussiana* (188)(+); *Hermannia quartiniana* (195)(+); *Hyparrhenia tamba* (188)(+); *Leonotis* species (189)(+); *Oxalis obliquifolia*

	(109)(+), (189)(+); *Panicum volutans* (107)(+); *Pentanisia angustifolia* (195)(+); *Pollichia campestris* (188)(+), (194)(+); *Portulaca quadrifida* (194)(+); *Themeda triandra* (109)(+); *Xenostegia tridentata* (195)(+); *Zornia linearis* (188)(+)
7.	*Acacia grandicornuta* (116)(+), (190)(+), (192)(+); *Aristida bipartita* (111)(+), (216)(+), (217)(+); *Carissa bispinosa* (116)(+), (192)(1); *Clematis brachiata* (110)(+), (111)(+), (217)(+); *Jasminum streptopus* (116)(a), (190)(+); *Securidaca longepedunculata* (116)(1), (190)(+); *Seddera suffruticosa* (110)(+), (217)(+), (219)(+); *Setaria verticillata* (139)(+), (217)(+), (218)(+)
7.1	*Argyrolobium tomentosum* (190)(+); *Aristida stipitata* (139)(+); *Aspilia mossambicensis* (192)(+); *Barleria macrostegia* (190)(+); *Combretum mossambicense* (111)(+); *Commelina* species (190)(+); *Cyphostemma simulans* (192)(+); *Indigofera setiflora* (190)(+); *Ornithogalum* species (190)(+); *Sarcostemma viminale* (192)(1); *Seddera capensis* (190)(+); *Strychnos henningsii* (190)(+); *Zehneria marlothii* (110)(+)
7.2	*Acacia robusta* (116)(1), (219)(+); *Cheilanthes* species (116)(+); *Digitaria diagonalis* (116)(a); *Eragrostis lehmanniana* (116)(+); *Flueggea virosa* (116)(+); *Hibiscus calyphyllus* (219)(1); *Ipomoea* species (216)(+), (218)(+); *Macrotyloma axillare* (218)(+), (219)(+); *Thunbergia neglecta* (218)(+)
No specific communiry	*Abrus precatorius* (97)(+), (221)(+); *Acacia erubescens* (96)(1), (111)(+), (138)(+), (217)(1); *Acalypha villicaulis* (117)(+), (157)(+); *Albizia anthelmintica* (192)(a), (193)(+); *Aristida diffusa* (138)(+), (191)(+); *Aristida scabrivalvis* (166)(+), (188)(+), (189)(+); *Asparagus setaceus* (138)(+), (222)(+); *Asparagus suaveolens* (112)(+), (147)(+), (188)(+); *Blepharis integrifolia* (96)(+), (112)(+), (166)(+); *Brachiaria serrata* (147)(+), (157)(+), (165)(+), (167)(+), (188)(+), (189)(+); *Brachylaena rotundata* (163)(+), (164)(+); *Bulbostylis humilis* (132)(+), (194)(+); *Cenchrus ciliaris* (125)(+), (216)(+), (217)(+); *Cleome rubella* (64)(+), (97)(+), (165)(+), (166)(+), (221)(+); *Commiphora schimperi* (112)(+), (116)(1), (139)(+), (166)(+), (167)(+), (188)(+), (195)(+); *Convolvulus sagittatus* (65)(+), (107)(+), (138)(+); *Corbichonia decumbens* (219)(+), (221)(+); *Cyphostemma schlechteri* (110)(+), (156)(+), (193)(+); *Dichapetalum cymosum* (97)(+), (194)(1); *Elionurus muticus* (167)(+), (188)(+); *Felicia mossamedensis* (97)(+), (166)(+); Gymnosporia polyacanthus (96)(+), (218)(+), (219)(+); *Hibiscus sidiformis* (138)(+), (139)(+), (216)(+), (217)(+); *Hibiscus trionum* (96)(+), (112)(+); *Hypoestes forskaolii* (162)(+), (163)(+), (217)(+), (218)(+); *Indigofera sessilifolia* (138)(+), (139)(+); *Ipomoea gracilisepala* (64)(+), (107)(+), (110)(+), (147)(+); *Kalanchoe paniculata* (97)(+), (117)(+); *Leucas*

	neuflizeana (110)(+), (111)(+), (113)(+), 125(1); *Lippia javanica* (116)(1), (162)(+), (188)(+); *Mariscus rehmannianus* (157)(+), (163)(+), (193)(+); *Microchloa caffra* (166)(+), (195)(+); *Mimusops zeyheri* (125)(+), (133)(1), (163)(+), (218)(+); *Mundulea sericea* (146)(+), (147)(+), (189)(+); *Nidorella anomala* (97)(+), (147)(a); *Ocimum angustifolium* (120)(+), (188)(+), (221)(+); *Osyris lanceolata* (133)(+), (162)(+), (163)(+); *Sesamum triphyllum* (64)(+), (193)(+); *Sphenostylis angustifolia* (110)(+), (111)(+), (144)(+), (146)(+); *Sporobolus fimbriatus* (96)(+), (107(+), (116)(+); *Striga gesnerioides* (64)(+), (132)(+), (188)(+), (193)(+); *Stylosanthes fruticosa* (164)(+), (188)(+), (189)(+); *Tragus berteronianus* (125)(+), (132)(+), (156)(+), (164)(+), (166)(+), (191)(+), (195)(+); *Urochloa mosambicensis* (113)(+), (124)(+), (139)(+); *Vigna frutescens* (156)(1), (218)(+); *Ximenia caffra (109*)(+), (133)(+), (163)(+), (165)(+), (190)(+), (219)(+); *Ziziphus mucronata* (96)(+), (107)(+), (112)(+), (195)(+); *Zornia milneana* (64)(+), (156)(+), (194)(+)

Chapter 8
Synthesis of data and recommendations for management

8.1 Introduction

Several researchers made use of synoptic tables to combine and summarise data from different phytosociological tables (Van der Meulen, 1979; Bezuidenhout, 1993; Brown, 1997; Cilliers, 1998; Van Wyk, 1998; Winterbach, 1998 and Götze, 2002). This is also important in the current study as it shows the relationship between the communities of phytosociological tables from the different land types and helps to form a better idea of the main vegetation types occurring in the Central Corridor Area (CCA) of the proposed Heritage Park. Identifying larger vegetation units also supports the comparison with other studies (Van Wyk, 1998). The visual editor for phytosociological tables, MEGATAB (Hennekens, 1996b) was used to combine the data from the phytosociological tables from the four land types described in Chapters 4 - 7 into a synoptic table (Table 8.1). The table was compiled from 222 relevés and consisted of 29 communities and sub-communities.

According to Van Rooyen (2006), vegetation is probably the most influential characteristic of any habitat and can reveal fundamental information about the habitat. Vegetation units are unique in terms of their carrying capacity, resilience to utilization and drought and the way they react to management practices, such as fire and grazing (Van Rooyen, 2006). They further differ in terms of their potential for utilization and challenges faced and each vegetation unit should be managed in a way that will optimally develop the potential and overcome specific challenges (Van Rooyen, 2006). The Fb land type, for example, has great potential for hiking routes and rock climbing, but it is also more sensitive to soil erosion. Another study was done on the carrying capacity and soil of the CCA by F. Viljoen from the Tshwane University of Technology. This data, in combination with the vegetation classification data, should be used to identify specific management units as described by Brown (1997). In this Chapter the vegetation units will be described in terms of environmental variables, diagnostic and dominant species, grazing value and veld condition. Some management recommendations will be given where relevant. Different use or tourism zones that have been proposed for the Heritage Park by Boonzaaier & Lourens (2002) will also be discussed.

8.2 Classification

The following three vegetation units and four vegetation sub-units were identified (Figure 8.1, Table 8.1):

1. *Acacia robusta – Acacia tortilis* Vegetation Unit
   - 1.1 *Eragrostis curvula – Setaria incrassata* Vegetation Sub-unit
   - 1.2 *Ptycholobium plicatum* subsp. *plicatum - Ziziphus mucronata* Vegetation Sub-unit

2. *Mundulea sericea – Vitex zeyheri* Vegetation Unit

3. *Grewia flavescens – Panicum maximum* Vegetation Unit
   - 3.1 *Commiphora schimperi – Pappea capensis* Vegetation Sub-unit
   - 3.2 *Combretum zeyheri – Waltheria indica* Vegetation Sub-unit

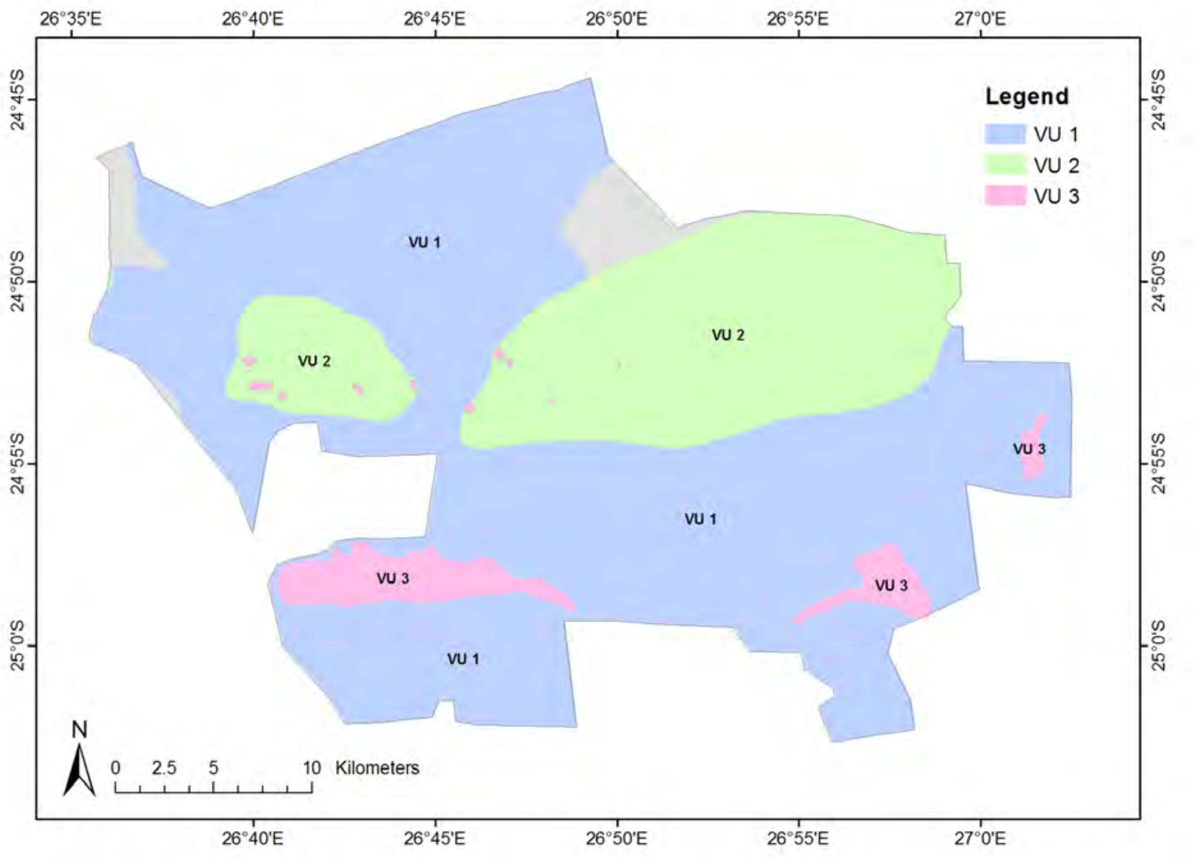

Figure 8.1 Map showing the Vegetation Units (VU) 1 – 3 of the Central Corridor Area (CCA) of the proposed Heritage Park.

Table 8.1 A synoptic table of the four land types present in the Central Corridor Area of the proposed Heritage Park

Land type	Ae	Ae	Ea	Ea	Ea	Ea	Ea	Ea	Ae	Ae	Ae	Ae	Ae	Ae	Fa	Fa	Fa	Fa	Fa	Fa	Fb	Fb	Fb	Fb	Fb	Fb	Fb	Fb	Fb
Community	5.1	5.2	3.1	3.2	4	2.2	1	2.1	2	1.1	1.3	1.2	3	4	1	2.1	2.2	3.2	3.1	4	1	7.1	7.2	3	5	4	6.1	6.2	2
Number of relevés	6	10	13	8	6	5	4	5	12	11	12	9	13	14	6	5	12	5	15	5	7	5	5	4	4	3	8	6	4
Vegetation units	1.1						1.2								2					3.1				3.2					
Species group A (Diagnostic species of Vegetation Unit 1)																													
Acacia tortilis	83	100	69	75	50	60	50	100	67	82	92	100	100	100	33	20	.	40	.	20	71	20	40	.	.	33	.	17	.
Acacia robusta	83	.	69	.	.	20	50	60	75	9	17	67	69	14	.	.	.	.	.	20	.	.	40	.	.	.	.	.	.
Asparagus setaceus	50	.	62	38	.	20	25	40	8	9	.	44	23	21	.	.	.	20	7	20	14	.	.	.	25	.	.	.	.
Bothriochloa insculpta	83	50	46	88	100	80	.	20	50	46	8	56	46	43	.	20	.	.	.	.	.	.	.	.	.	.	.	.	.
Brachiaria eruciformis	100	100	85	75	67	100	.	.	25	18	.	22	31	14	.	.	8	.	7	.	.	.	.	.	.	.	13	.	.
Viscum capense	67	.	31	13	.	.	25	.	17	27	8	.	23	14	.	.	.	.	.	.	.	.	.	.	.	.	13	.	.
Rhus pyroides	.	.	39	75	17	.	75	.	17	55	8	11	15	50	17	20	.	.	.	.	.	.	.	.	.	.	.	.	.
Ziziphus zeyheriana	17	30	46	63	.	60	25	20	8	.	17	.	.	.	.	60	.	.	.	.	.	.	.	.	.	.	.	.	.
Diospyros lycioides	67	20	.	38	.	.	100	.	.	9	8	11	8	29	.	.	17	.	.	.	.	.	.	.	.	.	.	.	.
Acacia mellifera	17	10	8	.	.	20	.	40	8	9	8	.	.	14	17	.	.	.	.	.	.	20	.	.	.	100	.	.	.
Malvastrum coromandelianum	17	.	23	.	17	20	.	20	8	.	.	.	8	14	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ipomoea papilio	17	.	.	.	33	40	.	.	.	9	25	11	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sporobolus nitens	17	.	.	.	.	20	25	.	.	9	.	11	46	.	.	.	.	20	.	.	.	.	.	.	.	.	.	.	.
Aristida adscensionis	33	20	.	.	.	20	.	.	.	.	.	22	31	36	.	.	.	.	.	.	43	20	.	.	.	33	13	.	25
Species group B (Diagnostic species of Vegetation Sub-unit 1.1)																													
Setaria incrassata	67	100	77	88	100	60	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Eragrostis curvula	67	50	39	100	33	60	25	.	8	.	.	22	.	.	.	.	17	.	.	.	.	.	.	.	.	.	38	50	.
Ischaemum afrum	100	100	92	100	33	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Crabbea hirsuta	50	60	62	38	.	80	.	.	50	.	8	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Orthosiphon amabilis	33	80	46	100	.	20	.	.	33	.	.	.	.	7	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Panicum schinzii	67	.	69	50	17	20	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rhus lancea	17	10	15	13	17	20	25	.	.	.	.	.	.	7	17	.	.	.	.	.	.	.	.	.	.	33	.	.	.
Urelytrum agropyroides	.	50	77	88	.	40	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dichanthium annulatum	.	60	23	88	33	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	17	.
Aspilia mossambicensis	.	90	23	100	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	20	.	.	.	.	.	.	.
Sorghum versicolor	33	.	15	.	83	.	.	.	8	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Commicarpus pentandrus	17	20	23	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Aristida rhiniochloa	.	.	23	.	17	20	.	.	.	.	.	.	8	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Table 8.1 (continued)																													
Land type	Ae	Ae	Ea	Ea	Ea	Ea	Ea	Ea	Ae	Ae	Ae	Ae	Ae	Ae	Fa	Fa	Fa	Fa	Fa	Fa	Fb	Fb	Fb	Fb	Fb	Fb	Fb	Fb	Fb
Community	5.1	5.2	3.1	3.2	4	2.2	1	2.1	2	1.1	1.3	1.2	3	4	1	2.1	2.2	3.2	3.1	4	1	7.1	7.2	3	5	4	6.1	6.2	2
Number of relevés	6	10	13	8	6	5	4	5	12	11	12	9	13	14	6	5	12	5	15	5	7	5	5	4	4	3	8	6	4
Vegetation units	1.1						1.2								2					3.1				3.2					
Species group C (Diagnostic species of Vegetation Sub-unit 1.2)																													
Ptycholobium plicatum s. plicatum	.	.	.	.	.	40	.	20	25	36	33	11	23	14	.	.	.	40	.	.	.	.	.	.	.	.	.	.	.
Cymbopogon nardus	17	.	.	.	.	40	.	20	50	9	8	33	23	7	.	.	.	20	.	.	.	.	.	.	.	.	.	50	25
Aptosimum procumbens	.	.	.	.	.	.	25	.	8	46	17	11	.	7	17	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Jatropha zeyheri	.	.	.	25	.	.	.	.	33	64	50	33	8	.	.	.	8	20	.	.	.	.	.	.	.	.	.	.	.
Eragrostis nindensis	.	.	8	.	.	20	.	.	.	36	8	22	8	7	.	.	.	.	7	.	.	.	.	.	.	33	.	.	.
Thesium utile	.	.	.	13	.	.	.	20	8	46	33	11	.	.	33	.	8	.	7	.	29	.	.	.	.	.	.	.	25
Pollichia campestris	.	.	.	13	.	.	75	.	.	9	33	.	8	21	50	.	.	.	.	.	.	.	.	.	.	.	.	33	.
Leucas capensis	.	.	15	.	.	.	.	20	.	.	8	11	8	29	.	.	.	.	7	.	.	.	.	.	.	.	.	.	.
Solanum lichtensteinii	.	.	.	.	.	.	.	.	8	18	8	22	8	.	.	20	8	.	.	.	.	.	.	.	.	.	.	.	.
Anthephora pubescens	.	.	.	.	.	.	.	40	8	73	33	.	.	.	.	.	58	.	.	.	29	.	.	.	.	.	.	.	.
Aloe greatheadii	.	.	.	.	.	20	25	.	.	.	.	33	8	29	17	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Elionurus muticus	.	.	.	.	.	.	.	.	17	9	17	22	.	.	.	.	8	.	.	.	.	.	.	.	.	.	.	17	25
Eragrostis trichophora	.	.	.	.	.	.	25	40	.	.	.	.	8	7	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sphedamnocarpus pruriens	.	.	.	.	.	20	.	.	17	9	8	.	.	7	.	.	17	.	.	.	.	.	.	.	.	.	.	17	100
Cynodon dactylon	.	.	.	.	17	.	75	.	.	.	.	11	.	43	.	.	8	.	.	.	.	.	.	.	.	.	.	.	.
Crotalaria lotoides	.	.	.	.	.	.	.	.	.	.	17	22	.	29	.	.	.	.	.	20	.	.	.	.	.	.	.	33	.
Ipomoea ommaneyi	.	.	.	.	.	.	.	.	.	9	42	11	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Seddera suffruticosa	.	10	.	.	.	.	.	40	17	18	.	.	.	.	33	.	.	.	.	.	.	20	40	.	.	.	.	.	.
Chamaecrista mimosoides	.	.	.	25	.	.	.	.	25	9	17	.	.	7	.	.	.	.	7	.	43	.	.	.	.	.	.	17	.
Gymnosporia senegalensis	.	.	15	.	.	.	.	60	17	.	.	.		7	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Merremia palmata	.	.	.	.	.	.	.	.	17	9	8	.	.	.	.	.	.	.	7	.	.	.	.	.	.	.	.	.	.
Polygala hottentotta	.	.	.	.	.	.	.	.	8	18	8	.	.		17	.	.	.	.	.	14	.	.	.	.	.	.	.	.

Table 8.1 (continued)																													
Land type	Ae	Ae	Ea	Ea	Ea	Ea	Ea	Ea	Ae	Ae	Ae	Ae	Ae	Ae	Fa	Fa	Fa	Fa	Fa	Fa	Fb	Fb	Fb	Fb	Fb	Fb	Fb	Fb	Fb
Community	5.1	5.2	3.1	3.2	4	2.2	1	2.1	2	1.1	1.3	1.2	3	4	1	2.1	2.2	3.2	3.1	4	1	7.1	7.2	3	5	4	6.1	6.2	2
Number of relevés	6	10	13	8	6	5	4	5	12	11	12	9	13	14	6	5	12	5	15	5	7	5	5	4	4	3	8	6	4
Vegetation units	1.1						1.2								2					3.1				3.2					
Species group D (Diagnostic species of Vegetation Unit 2)																													
Vitex zeyheri	.	.	.	.	.	.	50	20	58	.	.	.	.	.	100	80	92	80	47	.	29	.	.	.	.	.	50	17	25
Mundulea sericea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	100	40	58	60	27	40	29	.	.	.	.	.	.	17	.
Hermannia stellulata	.	.	.	.	.	.	.	.	.	9	.	.	.	.	50	20	42	20	20	.	.	.	.	.	.	.	.	.	100
Lippia javanica	.	.	.	.	.	.	100	.	.	.	.	.	.	.	100	20	33	20	.	.	.	.	20	25	.	.	.	17	.
Sida cordifolia	.	.	.	.	.	.	100	.	.	9	.	.	.	21	33	.	33	60	47	.	.	.	.	.	.	67	.	17	.
Oxalis smithiana	.	.	.	.	.	.	50	.	.	.	.	.	.	.	17	.	17	20	13	20	.	.	.	.	.	.	.	.	.
Rhoicissus tridentata	.	.	.	.	.	.	.	.	8	.	.	.	.	.	.	20	8	20	7	20	.	.	.	50	.	.	.	.	.
Cleome monophylla	.	.	.	.	.	.	.	.	.	.	.	.	.	7	.	20	33	.	60	20	.	.	.	.	.	33	.	.	.
Hyparrhenia hirta	.	.	.	.	.	40	.	.	.	18	.	11	.	.	50	20	8	.	.	.	.	.	.	.	.	.	.	.	.
Rhynchosia densiflora s. *chrysandenia*	.	.	.	.	.	40	.	.	17	.	.	11	.	.	17	20	.	40	.	.	.	.	.	.	.	.	.	.	.
Dicoma anomala	.	.	.	.	.	.	.	.	.	.	.	11	.	.	17	20	33	.	.	.	.	.	.	.	.	.	13	.	.
Chenopodium carinatum	.	.	.	.	.	.	25	.	.	.	.	.	.	.	.	20	25	.	20	.	14	.	.	.	.	.	.	.	.
Pseudognaphalium undulatum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	33	20	13	.	.	.	.	.	.	.	13	.	.
Boophone disticha	.	.	.	.	.	.	.	.	.	9	.	11	.	.	.	20	33	.	7	.	.	.	.	.	.	33	.	.	.
Sida ovata	.	.	.	.	.	.	.	.	.	9	.	.	15	.	.	20	17	.	20	.	.	.	.	.	.	.	13	.	.
Acalypha villicaulis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	20	17	20	.	.	.	.	.	25	.	.	13	.	.
Acrotome inflata	17	.	.	.	.	.	.	.	.	9	.	.	.	.	.	20	25	.	7	.	.	.	.	.	.	.	.	.	.

Table 8.1 (continued)

Land type	Ae	Ae	Ea	Ea	Ea	Ea	Ea	Ea	Ae	Ae	Ae	Ae	Ae	Ae	Fa	Fa	Fa	Fa	Fa	Fa	Fb	Fb	Fb	Fb	Fb	Fb	Fb	Fb	Fb
Community	5.1	5.2	3.1	3.2	4	2.2	1	2.1	2	1.1	1.3	1.2	3	4	1	2.1	2.2	3.2	3.1	4	1	7.1	7.2	3	5	4	6.1	6.2	2
Number of relevés	6	10	13	8	6	5	4	5	12	11	12	9	13	14	6	5	12	5	15	5	7	5	5	4	4	3	8	6	4
Vegetation units	1.1						1.2								2					3.1				3.2					
Species group E																													
Monsonia angustifolia	17	10	.	13	.	60	.	20	50	64	17	67	69	29	17	20	17	80	13	.	100	.	.	.	.	.	.	.	25
Aristida congesta s. *barbicollis*	.	.	.	.	.	40	25	.	8	64	83	78	15	57	.	40	17	20	7	.	.	.	.	.	.	.	.	.	.
Combretum imberbe	17	.	.	.	.	.	50	20	83	46	8	.	15	.	17	60	17	60	13	.	.	.	.	.	.	.	.	.	.
Heliotropium steudneri	.	.	8	.	.	.	.	20	8	46	33	33	8	36	33	.	92	40	53	.	.	.	.	.	.	.	.	.	.
Indigofera rhytidocarpa s. *rhytidocarpa*	.	.	.	.	.	.	.	20	8	.	8	11	23	14	33	.	8	40	7	.	.	.	.	.	.	.	.	.	.
Nidorella resedifolia s. *resedifolia*	.	.	.	.	.	40	.	80	25	18	8	.	31	7	33	.	25	60	40	.	57	20	.	.	.	.	13	.	.
Sida dregei	.	.	.	.	.	.	.	20	8	18	75	44	.	14	17	40	17	.	.	.	.	.	.	.	.	.	13	17	.
Barleria macrostegia	.	.	.	.	.	.	.	20	42	9	25	33	.	.	33	60	33	20	13	.	.	20	.	.	.	.	.	.	.
Eragrostis superba	.	.	.	.	.	.	25	20	8	73	50	.	.	.	33	80	58	40	.	.	.	.	.	.	.	.	.	.	.
Leucas sexdentata	.	.	.	.	.	40	50	.	25	.	.	11	8	7	67	.	50	60	53	20	.	.	.	.	.	.	.	.	.
Ledebouria revoluta	.	.	.	.	.	.	.	.	17	36	25	11	8	36	17	.	50	.	7	60	.	.	.	.	.	.	13	.	.
Withania somnifera	.	.	8	.	.	.	.	.	8	18	.	22	.	7	17	100	25	.	13	.	.	.	.	.	.	.	.	.	.
Oxalis obliquifolia	.	.	.	.	.	.	25	.	.	64	42	67	.	36	.	60	.	20	7	.	.	.	.	.	.	.	.	33	.
Stylosanthes fruticosa	.	.	.	.	.	.	25	.	.	9	.	.	8	.	33	20	17	20	7	.	.	.	.	.	.	.	.	33	25
Tarchonanthus camphoratus	17	.	.	.	.	80	.	100	25	9	.	.	.	.	17	80	67	.	20	.	.	.	.	.	.	33	.	.	.
Solanum tettense v. *renschii*	.	.	.	.	.	.	.	.	8	36	8	22	15	7	.	40	8	.	.	.	.	.	.	.	.	.	.	.	.
Raphionacme velutina	.	.	.	.	.	.	25	.	.	.	17	11	15	.	17	20	17	.	27	.	.	.	.	25	.	.	.	17	.
Felicia mossamedensis	.	.	.	.	.	.	.	40	8	9	.	11	8	.	33	20	.	20	.	.	.	.	.	.	.	33	.	.	25
Hirpicium bechuanense	.	.	.	.	.	.	.	.	.	27	75	56	8	71	.	20	.	20	.	.	.	.	.	.	.	.	.	.	25
Crabbea angustifolia	.	.	.	.	.	.	.	.	8	36	42	56	8	.	.	40	8	.	.	.	.	.	.	.	.	.	.	17	.
Raphionacme hirsuta	.	.	.	.	.	.	.	.	17	46	67	56	8	.	.	20	17	.	.	.	.	.	.	.	.	.	.	.	.
Geigeria burkei	.	.	.	.	.	.	25	80	.	.	17	.	15	.	33	.	8	.	.	.	.	.	.	.	.	.	.	.	.
Talinum arnotii	.	10	.	.	.	.	.	.	8	9	.	.	15	14	.	.	17	.	60	20	.	.	.	.	.	.	.	.	.
Dicoma macrocephala	.	.	.	.	.	.	.	20	.	18	8	.	.	7	67	.	42	.	.	.	.	.	.	.	.	.	.	.	.
Cucumis metuliferus	.	.	.	.	.	.	.	.	.	9	.	11	8	.	.	20	8	.	7	.	.	.	.	.	.	.	.	.	.
Sida rhombifolia	.	.	8	.	.	.	.	.	.	27	.	.	8	21	.	.	.	20	7	.	.	40	.	.	.	.	.	50	.
Tribulus terrestris	.	.	.	.	.	.	.	.	.	.	.	.	31	7	17	20	.	.	.	.	.	.	.	.	.	.	.	.	.

Table 8.1 (continued)																													
Land type	Ae	Ae	Ea	Ea	Ea	Ea	Ea	Ea	Ae	Ae	Ae	Ae	Ae	Ae	Fa	Fa	Fa	Fa	Fa	Fa	Fb	Fb	Fb	Fb	Fb	Fb	Fb	Fb	Fb
Community	5.1	5.2	3.1	3.2	4	2.2	1	2.1	2	1.1	1.3	1.2	3	4	1	2.1	2.2	3.2	3.1	4	1	7.1	7.2	3	5	4	6.1	6.2	2
Number of relevés	6	10	13	8	6	5	4	5	12	11	12	9	13	14	6	5	12	5	15	5	7	5	5	4	4	3	8	6	4
Vegetation units	1.1						1.2								2					3.1				3.2					
Species group F																													
Ziziphus mucronata	100	40	85	25	17	80	100	100	58	73	33	100	92	79	67	80	8	40	7	40	14	.	.	.	.	33	.	33	.
Urochloa mosambicensis	67	30	31	.	17	20	100	20	42	73	58	89	85	93	83	80	83	80	33	.	14	20	.	.	.	.	13	.	.
Asparagus suaveolens	83	60	85	25	.	40	75	40	50	46	33	89	92	64	.	40	25	.	13	.	29	.	.	.	.	.	.	17	.
Cucumis zeyheri	.	10	46	.	33	80	50	20	.	46	33	44	15	29	67	60	92	60	27	20	14	.	.	.	.	.	.	.	.
Hibiscus trionum	83	90	77	75	67	100	.	40	75	55	17	67	23	43	67	20	.	60	.	.	14	.	.	.	.	33	.	.	.
Cymbopogon pospischilii	67	90	100	100	.	100	25	60	100	91	100	100	38	29	.	60	17	40	.	.	.	.	.	.	.	.	.	17	.
Sida spinosa	50	30	31	.	67	80	100	40	75	55	.	56	54	7	.	100	8	80	.	.	29	.	.	.	.	67	.	.	.
Chloris virgata	83	30	39	.	33	40	75	.	8	27	8	67	62	64	.	60	25	.	.	.	.	.	.	.	.	.	.	.	.
Corchorus asplenifolius	33	60	31	63	.	.	.	.	50	46	50	22	23	29	33	.	33	20	47	.	.	.	.	.	.	.	.	17	100
Hibiscus pusillus	50	40	8	13	.	20	.	.	25	46	67	44	23	14	50	20	8	.	7	.	14	.	.	.	.	.	.	.	.
Combretum hereroense	33	.	15	.	.	80	25	60	67	27	.	11	23	.	83	40	8	40	13	.	29	.	.	.	.	.	.	.	.
Fingerhuthia africana	50	60	69	25	50	80	.	60	75	18	17	.	15	.	67	20	17	.	27	40	.	.	.	.	.	.	.	.	.
Panicum coloratum	50	70	62	50	.	40	.	80	92	73	100	100	31	21	17	.	.	20	.	.	14	.	.	.	.	.	.	.	.
Themeda triandra	17	50	15	88	.	20	.	.	42	64	92	56	23	21	.	60	17	.	.	.	.	.	.	.	.	.	.	17	.
Nidorella anomala	.	10	.	50	.	.	50	20	25	27	50	.	8	29	33	.	17	20	20	.	14	.	.	.	.	33	.	.	.
Indigofera heterotricha	17	.	.	13	.	40	.	80	50	27	50	22	15	.	.	20	25	20	7	.	29	20	.	.	.	.	.	.	.
Indigofera charlieriana v. *charlieriana*	33	50	69	.	33	80	.	100	50	.	.	.	23	14	33	.	.	20	7	.	14	.	.	.	.	.	.	.	.
Elephantorrhiza elephantina	.	.	.	25	.	40	.	.	33	55	58	.	.	.	17	40	25	20	33	.	.	.	.	.	.	.	.	.	.
Vernonia oligocephala	33	50	23	63	.	20	.	.	25	9	25	11	.	.	.	60	8	.	.	.	.	.	.	.	.	.	.	.	25
Aerva leucura	17	.	8	.	.	20	50	60	8	.	.	.	.	14	.	.	8	40	7	20	.	.	.	25	.	.	.	.	.
Asparagus laricinus	33	50	31	75	.	20	.	.	.	.	8	11	.	7	.	.	.	20	13	.	.	.	.	.	.	.	.	.	.
Tapinanthus species	17	.	.	.	.	20	.	.	.	36	.	.	15	.	33	60	42	.	7	20	.	.	.	.	.	.	.	.	.
Eragrostis racemosa	17	10	.	.	.	20	.	.	8	.	.	.	38	.	.	60	.	20	.	.	.	.	.	.	.	.	.	.	.
Convolvulus sagittatus	.	70	.	50	.	.	.	.	17	9	.	11	8	.	.	.	67	.	7	.	14	.	.	.	.	.	13	17	.

Table 8.1 (continued)

Land type	Ae	Ae	Ea	Ea	Ea	Ea	Ea	Ea	Ae	Ae	Ae	Ae	Ae	Ae	Fa	Fa	Fa	Fa	Fa	Fa	Fb	Fb	Fb	Fb	Fb	Fb	Fb	Fb	Fb
Community	5.1	5.2	3.1	3.2	4	2.2	1	2.1	2	1.1	1.3	1.2	3	4	1	2.1	2.2	3.2	3.1	4	1	7.1	7.2	3	5	4	6.1	6.2	2
Number of relevés	6	10	13	8	6	5	4	5	12	11	12	9	13	14	6	5	12	5	15	5	7	5	5	4	4	3	8	6	4
Vegetation units	1.1						1.2								2					3.1				3.2					
Species group G																													
Grewia flavescens	.	.	.	.	.	20	.	.	8	.	.	11	8	7	17	.	.	40	13	20	29	80	100	75	75	100	38	50	25
Bridelia mollis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	20	.	60	29	.	60	100	50	100	75	100	50
Polygala sphenoptera	.	.	.	.	.	.	.	.	25	.	.	.	.	7	.	.	.	.	20	40	.	20	.	50	50	33	38	100	100
Commelina benghalensis	.	10	15	13	.	.	25	20	8	.	8	.	8	43	.	.	.	.	27	100	.	20	80	75	50	67	13	33	.
Andropogon chinensis	.	.	.	.	.	.	.	.	33	.	.	.	.	.	.	.	.	.	7	.	71	20	.	25	100	67	13	.	100
Croton gratissimus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	80	.	100	60	50	100	33	13	.	.
Berchemia zeyheri	.	.	.	.	.	20	.	40	50	.	.	.	23	.	17	.	.	.	.	40	29	40	60	75	.	33	.	17	.
Vangueria infausta	.	.	.	.	.	.	50	.	.	.	.	.	.	7	.	.	.	.	13	.	29	.	.	100	50	.	25	100	25
Pavonia transvaalensis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	14	40	.	.	100	33	25	100	.
Psiadia punctulata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	33	.	.	.	.	.	.	80	20	.	75	33	13	50	.
Ipomoea magnusiana	.	.	.	.	.	.	.	.	.	.	8	.	.	.	.	.	8	.	.	20	14	20	.	75	25	.	63	.	.
Euclea natalensis	.	.	.	.	.	20	.	40	.	.	.	.	.	.	.	20	8	.	.	20	.	40	.	50	25	.	25	17	.
Commiphora schimperi	.	.	.	.	.	.	.	.	.	.	.	.	8	.	.	.	.	20	.	20	14	20	20	.	.	.	.	33	50
Ximenia caffra	.	.	.	.	.	.	.	20	8	.	.	.	.	.	17	.	8	.	.	.	.	20	20	25	.	.	13	17	25
Hibiscus micranthus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	60	60	25	25	.	13	.	.
Plumbago zeylanica	.	.	.	.	.	.	.	.	.	.	.	.	.	7	.	.	.	.	.	20	.	20	60	25	.	.	.	17	.
Melhania acuminata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	33	.	.	.	.	.	14	20	20	.	50	.	13	.	.
Indigofera vicioides v. *vicioides*	.	.	.	.	.	.	25	.	.	.	.	.	.	.	.	.	.	.	.	.	.	60	40	.	100	67	.	.	.
Enteropogon macrostachyus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	60	100	25	50	.	.	.	.
Spirostachys africana	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	80	100	25	25	.	.	.	.
Gomphocarpus fruticosus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	7	.	14	.	.	.	.	67	100	17	.
Blepharis maderaspatensis	.	.	8	.	.	.	.	20	.	.	.	.	.	.	.	.	.	.	.	.	.	20	40	.	75	33	.	.	.
Triumfetta annua	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	80	50	50	.	.	33	.
Tephrosia rhodesica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	14	20	.	25	50	.	.	.	.
Boscia albitrunca	.	.	.	.	.	.	.	.	.	.	.	11	8	.	.	.	.	.	.	.	.	40	20	.	25	33	.	.	.
Secamone parvifolia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	60	80	.	75	.	.	.	.

Table 8.1 (continued)																													
Land type	Ae	Ae	Ea	Ea	Ea	Ea	Ea	Ea	Ae	Ae	Ae	Ae	Ae	Ae	Fa	Fa	Fa	Fa	Fa	Fa	Fb	Fb	Fb	Fb	Fb	Fb	Fb	Fb	Fb
Community	5.1	5.2	3.1	3.2	4	2.2	1	2.1	2	1.1	1.3	1.2	3	4	1	2.1	2.2	3.2	3.1	4	1	7.1	7.2	3	5	4	6.1	6.2	2
Number of relevés	6	10	13	8	6	5	4	5	12	11	12	9	13	14	6	5	12	5	15	5	7	5	5	4	4	3	8	6	4
Vegetation units	1.1						1.2								2					3.1				3.2					
Species group H																													
**Zinnia peruviana*	83	10	100	38	100	100	100	80	58	55	17	22	46	14	100	80	67	80	87	100	57	20	60	25	.	.	.	.	25
Pavonia burchellii	50	.	46	13	.	20	25	60	42	36	33	33	69	57	.	60	8	40	20	40	14	20	80	.	.	33	.	.	.
Acacia karroo	83	90	54	100	17	100	75	100	42	55	33	56	38	43	33	100	8	20	7	.	14	.	80	.	.	.	.	.	25
Setaria verticillata	83	10	77	.	.	20	75	40	33	18	.	44	46	7	.	80	8	100	27	.	.	20	40	.	.	.	.	.	.
Aristida bipartita	.	40	62	25	67	.	.	40	25	9	.	44	15	.	.	20	8	.	20	60	.	20	40	.	.	.	.	.	.
Gymnosporia buxifolia	17	.	8	.	.	40	50	60	58	18	.	11	54	7	.	20	.	60	7	60	.	60	20	.	.	.	.	.	.
Sphenostylis angustifolia	.	.	8	13	.	20	.	40	17	9	8	.	8	7	.	20	8	.	.	60	29	40	.	.	.	.	.	.	.
Ehretia rigida	50	10	39	.	.	60	50	60	25	18	25	56	62	29	.	20	17	20	.	40	.	80	60	.	.	.	.	17	.
Indigofera daleoides	33	.	15	13	.	.	25	40	50	100	67	44	23	7	17	.	17	80	40	20	43	.	.	.	.	.	.	33	75
Aristida diffusa	33	50	.	75	33	.	25	.	8	73	25	44	23	7	50	40	75	40	60	40	14	.	.	.	25	.	.	.	.
Cenchrus ciliaris	17	10	8	.	50	.	.	20	33	.	.	22	15	29	.	20	.	40	.	20	.	.	40	.	.	33	.	.	.
Ipomoea gracilisepala	50	60	23	25	33	20	.	.	.	.	.	11	15	7	33	.	.	.	13	.	14	20	.	.	.	.	13	17	.
Clematis brachiata	.	.	.	.	17	.	75	.	.	.	.	11	8	7	17	40	17	.	7	20	.	40	20	.	.	.	.	.	.
Crotalaria sphaerocarpa	33	10	23	.	17	20	25	.	.	.	.	11	8	14	.	.	.	.	20	60	86	.	.	.	.	.	.	.	.
Ipomoea coscinosperma	.	.	23	38	.	.	25	.	.	.	.	11	23	.	.	.	8	60	27	.	14	40	.	.	.	.	38	.	.
Flueggea virosa	.	.	8	.	.	40	50	.	17	9	.	.	23	.	.	.	.	40	.	40	.	.	20	.	.	.	.	.	.
Blepharis integrifolia	17	.	8	.	17	.	.	.	.	27	25	.	8	29	33	.	.	.	7	.	14	.	.	.	.	33	.	.	25

Table 8.1 (continued)

Land type	Ae	Ae	Ea	Ea	Ea	Ea	Ea	Ea	Ae	Ae	Ae	Ae	Ae	Ae	Fa	Fa	Fa	Fa	Fa	Fa	Fb	Fb	Fb	Fb	Fb	Fb	Fb	Fb	Fb
Community	5.1	5.2	3.1	3.2	4	2.2	1	2.1	2	1.1	1.3	1.2	3	4	1	2.1	2.2	3.2	3.1	4	1	7.1	7.2	3	5	4	6.1	6.2	2
Number of relevés	6	10	13	8	6	5	4	5	12	11	12	9	13	14	6	5	12	5	15	5	7	5	5	4	4	3	8	6	4
Vegetation units	1.1						1.2								2					3.1				3.2					
Species group I (Diagnostic species of Vegetation Sub-unit 3.2)																													
Combretum zeyheri	.	.	.	.	.	.	.	.	.	.	.	.	.	.	17	.	8	.	40	.	.	.	.	100	75	100	100	100	75
Oldenlandia herbacea	.	.	.	.	.	.	.	.	.	.	.	.	8	.	.	.	.	.	.	.	.	.	.	50	25	67	100	67	50
Gisekia pharnacioides	.	.	.	.	.	.	.	.	.	.	.	.	.	29	.	.	.	.	13	.	.	.	.	50	25	33	25	33	75
Burkea africana	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	25	.	33	75	100	100
Terminalia sericea	.	.	.	.	.	.	25	.	.	.	.	.	.	7	17	.	17	.	20	.	.	.	.	.	25	33	50	100	100
Canthium mundianum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	60	.	75	75	33	25	17	.
Hibiscus engleri	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	75	50	33	38	17	.
Kyllinga alba	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	17	.	27	.	.	.	.	50	.	33	25	17	50
Hermannia glanduligera	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	8	.	20	.	14	.	.	.	25	33	13	50	50
Tephrosia longipes	.	.	.	.	.	20	.	.	.	9	.	.	.	.	.	.	.	.	.	20	.	.	.	100	50	.	63	50	.
Tragia rupestris	.	.	.	.	.	.	.	.	8	.	.	.	.	.	.	.	.	.	7	20	.	.	.	50	75	67	.	83	.
Bulbostylis hispidula	.	.	.	.	.	.	25	.	.	.	.	.	.	.	.	.	8	.	7	.	.	.	.	25	.	.	88	67	50
Xerophyta retinervis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	42	.	20	.	.	.	.	.	25	33	88	33	.
Cleome rubella	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	25	.	7	.	.	.	.	.	25	33	13	.	50
Melinis nerviglumis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	25	25	33	38	.	.
Cyperus obtusiflorus	.	.	.	.	.	.	.	.	.	18	.	.	.	.	.	.	.	.	7	.	.	.	.	25	.	.	.	50	75
Cyperus fulgens	.	.	.	.	.	.	.	.	.	.	.	.	.	7	.	.	.	.	.	20	.	.	.	75	50	.	.	17	.
Indigofera comosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	33	75	67	.
Englerophytum magalismontanum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	50	.	.	63	17	.
Trichoneura grandiglumis	.	.	.	.	.	.	.	.	.	.	8	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	50	17	50
Ficus glumosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	20	.	50	.	.	38	17	.
Strychnos pungens	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	25	.	.	38	33	.
Ochna pulchra	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	25	.	13	100	.
Strychnos madagascariensis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	20	.	.	25	.	13	67	.
Schizachyrium jeffreysii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	8	.	.	.	.	.	.	.	.	33	63	17	.
Strychnos spinosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	50	.	13	17	.
Striga gesnerioides	.	.	.	.	.	.	.	.	8	.	8	.	.	.	.	.	.	40	.	.	.	.	.	.	25	.	25	17	.
Mimusops zeyheri	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	20	25	.	33	13	.	.
Ocimum angustifolium	.	.	.	.	.	20	.	.	.	.	.	.	.	.	17	.	.	.	7	20	.	.	.	.	25	.	13	17	.

Table 8.1 (continued)																													
Land type	Ae	Ae	Ea	Ea	Ea	Ea	Ea	Ea	Ae	Ae	Ae	Ae	Ae	Ae	Fa	Fa	Fa	Fa	Fa	Fa	Fb	Fb	Fb	Fb	Fb	Fb	Fb	Fb	Fb
Community	5.1	5.2	3.1	3.2	4	2.2	1	2.1	2	1.1	1.3	1.2	3	4	1	2.1	2.2	3.2	3.1	4	1	7.1	7.2	3	5	4	6.1	6.2	2
Number of relevés	6	10	13	8	6	5	4	5	12	11	12	9	13	14	6	5	12	5	15	5	7	5	5	4	4	3	8	6	4
Vegetation units	1.1						1.2								2					3.1				3.2					
Species group J																													
Waltheria indica	17	.	.	.		20	.	.	8	36	.	.	8	14	83	20	58	100	73	40	14	40	.	100	100	100	100	100	100
Combretum apiculatum	.	.	.	.	.	40	.	.	33	.	.	.	15	.	83	20	25	100	87	60	100	80	20	50	75	67	13	50	100
Chrysopogon serrulatus	.	.	.	.	.	.	.	80	.	18	.	.	.	.	33	20	67	.	47	100	100	20	.	100	75	67	50	33	50
Ceratotheca triloba	.	20	23	.	.	.	.	20	.	46	8	.	8	.	17	40	75	20	73	20	43	40	.	25	50	33	63	50	.
Combretum molle	.	.	.	.	.	.	50	.	.	.	.	.	.	.	.	.	17	80	47	20	.	40	80	100	100	67	100	83	75
Pellaea calomelanos	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	17	20	27	20	14	80	20	100	100	100	88	100	.
Lannea discolor	.	.	.	.	.	.	.	.	8	.	.	.	.	.	.	.	17	20	47	.	29	40	.	100	50	67	100	33	25
Commiphora mollis	.	.	.	.	.	.	25	.	.	.	.	.	.	.	.	.	.	60	7	60	29	100	20	25	75	67	.	50	.
Brachiaria deflexa	.	.	8	.	.	.	25	.	8	.	.	11	.	14	.	.	.	20	47	.	14	20	80	100	50	67	.	.	.
Pogonarthria squarrosa	.	.	.	.	.	.	.	.	33	18	.	11	.	7	50	40	58	.	47	.	.	.	.	50	.	.	38	33	100
Bulbostylis humilis	.	.	.	.	.	.	.	60	8	.	.	.	.	.	67	.	67	20	93	100	.	.	.	.	.	.	13	17	.
Leucas neuflizeana	.	.	.	.	.	.	.	.	.	.	.	.	.	7	.	.	.	40	7	.	14	40	.	.	.	33	.	.	.

Table 8.1 (continued)																													
Land type	Ae	Ae	Ea	Ea	Ea	Ea	Ea	Ea	Ae	Ae	Ae	Ae	Ae	Ae	Fa	Fa	Fa	Fa	Fa	Fa	Fb	Fb	Fb	Fb	Fb	Fb	Fb	Fb	Fb
Community	5.1	5.2	3.1	3.2	4	2.2	1	2.1	2	1.1	1.3	1.2	3	4	1	2.1	2.2	3.2	3.1	4	1	7.1	7.2	3	5	4	6.1	6.2	2
Number of relevés	6	10	13	8	6	5	4	5	12	11	12	9	13	14	6	5	12	5	15	5	7	5	5	4	4	3	8	6	4
Vegetation units	1.1						1.2								2					3.1				3.2					
Species group K																													
Panicum maximum	.	.	8	.	.	.	100	.	33	36	25	56	77	100	.	.	.	20	7	20	29	100	100	100	100	100	63	33	25
Kyphocarpa angustifolia	.	.	.	.	.	40	25	100	50	18	.	33	67	43	33	.	.	100	60	20	14	20	20	.	75	67	88	67	25
Tragus berteronianus	17	.	.	.	.	.	25	.	33	55	25	89	77	71	.	60	58	20	47	20	.	.	.	25	25	33	13	17	50
Rhynchosia totta	17	.	.	.	.	60	25	40	17	9	33	.	23	7	67	20	17	20	47	40	14	80	.	100	50	67	38	50	.
Sclerocarya birrea	.	.	8	.	17	.	25	.	58	18	.	11	15	.	67	20	50	80	100	80	86	80	80	25	75	33	38	.	25
Evolvulus alsinoides	.	.	.	.	.	.	.	40	25	55	8	22	23	36	50	.	8	.	13	20	71	20	60	.	75	100	63	83	50
Aristida congesta s. *congesta*	17	.	.	.	.	40	50	.	42	64	33	100	38	36	33	80	92	40	67	40	.	.	.	.	25	.	38	83	100
Grewia monticola	.	.	.	.	.	.	.	60	75	.	.	11	23	43	.	.	.	40	33	40	71	100	80	100	75	100	63	50	50
Pappea capensis	33	.	.	.	.	.	25	60	50	9	8	11	23	.	.	20	.	40	20	100	14	100	100	25	25	33	.	33	.
Dombeya rotundifolia	.	.	8	.	.	.	25	60	67	18	.	.	8	7	83	100	42	100	53	60	29	.	.	50	.	67	13	50	50
Peltophorum africanum	.	.	.	.	.	.	100	.	.	46	.	33	31	29	.	.	.	20	13	20	29	20	60	100	50	67	75	33	100
Ruellia cordata	17	20	.	13	.	.	25	60	25	27	8	22	69	50	17	.	25	.	.	.	14	20	60	.	.	33	.	33	.
Melhania prostrata	.	.	.	.	.	.	25	.	17	9	.	22	23	.	33	.	.	40	13	.	.	80	20	100	25	100	13	50	25
Schmidtia pappophoroides	.	.	.	.	.	.	.	.	67	82	75	44	31	43	33	40	75	60	47	.	29	.	.	.	.	33	38	.	100
Ximenia americana	17	.	.	.	.	.	.	.	8	18	.	11	38	14	.	.	.	.	27	.	43	40	60	50	25	67	25	17	50
Brachiaria nigropedata	.	.	.	.	.	.	.	.	.	73	83	67	15	14	.	20	75	.	13	.	71	20	.	50	.	33	13	17	100
Chascanum hederaceum	.	.	.	.	.	.	.	.	42	64	58	22	8	.	17	80	33	20	7	.	57	.	.	.	25	33	13	67	50
Ozoroa paniculosa	.	.	.	.	.	20	.	40	33	36	8	.	8	.	100	60	75	40	80	.	.	.	.	.	25	33	63	17	50
Pupalia lappacea	.	.	.	.	.	40	50	40	8	.	.	.	38	21	.	.	.	20	.	20	.	100	80	50	25	67	.	17	.
Eragrostis biflora	17	.	.	.	.	.	25	.	.	.	8	44	38	29	.	20	8	.	7	.	.	.	20	25	.	33	25	100	.
Eustachys paspaloides	.	.	.	.	.	20	.	.	83	18	50	56	8	.	33	100	50	20	7	.	.	.	.	75	.	33	.	33	25
Phyllanthus parvulus	.	.	8	.	.	.	50	.	8	.	75	.	.	21	.	20	42	.	13	40	.	.	20	25	50	.	50	33	.
Chamaecrista biensis	.	.	.	.	.	.	.	.	.	18	17	.	8	7	50	20	67	20	73	.	.	.	.	.	.	.	.	17	100
Ocimum americanum	.	.	.	.	.	.	75	40	25	.	.	.	8	7	17	.	.	20	.	.	.	.	20	50	25	.	.	17	.
Abutilon angulatum	17	.	.	.	.	40	.	.	33	18	8	22	31	50	.	.	.	.	.	.	29	20	100	50	.	33	.	.	.
Sporobolus fimbriatus	.	.	.	.	.	.	.	.	.	18	.	.	23	29	.	80	33	.	53	80	.	.	20	.	.	33	.	17	.
Pavonia senegalensis	17	.	.	.	.	.	.	.	8	.	.	11	38	14	17	.	.	.	.	20	.	60	20	25	25	.	.	.	.
Indigofera filipes	.	.	.	.	.	20	50	.	17	.	.	.	15	7	17	.	42	80	73	40	.	.	.	25	.	33	63	.	.
Setaria pumila	17	.	.	.	.	.	.	.	.	.	.	11	8	7	17	.	.	20	7	.	43	.	20	.	50	.	25	17	.
Hermannia tomentosa	.	.	.	.	.	.	.	.	8	82	33	.	8	21	.	.	50	.	.	.	.	.	.	.	50	.	38	100	.
Brachiaria serrata	.	.	.	.	.	.	.	.	8	18	17	.	8	.	.	20	25	.	.	.	14	.	.	25	.	.	.	33	50
Sesamum triphyllum	.	10	.	.	.	.	25	.	.	9	.	.	8	.	17	.	25	.	20	20	.	.	.	.	25	.	13	.	.
Vigna frutescens	.	.	.	.	.	.	.	.	25	.	8	11	.	.	.	20	17	.	13	20	.	.	20	25	.	.	.	.	.

Table 8.1 (continued)																													
Land type	Ae	Ae	Ea	Ea	Ea	Ea	Ea	Ea	Ae	Ae	Ae	Ae	Ae	Ae	Fa	Fa	Fa	Fa	Fa	Fa	Fb	Fb	Fb	Fb	Fb	Fb	Fb	Fb	Fb
Community	5.1	5.2	3.1	3.2	4	2.2	1	2.1	2	1.1	1.3	1.2	3	4	1	2.1	2.2	3.2	3.1	4	1	7.1	7.2	3	5	4	6.1	6.2	2
Number of relevés	6	10	13	8	6	5	4	5	12	11	12	9	13	14	6	5	12	5	15	5	7	5	5	4	4	3	8	6	4
Vegetation units	1.1						1.2								2					3.1				3.2					
Species group K (continued)																													
Acacia burkei	.	.	.	.	.	.	25	.	.	.	.	.	8	14	.	.	.	20	33	40	.	20	60	25	.	.	.	.	.
Grewia bicolor	.	.	.	.	.	.	.	.	8	.	8	.	15	.	.	.	.	.	7	.	14	40	100	.	.	33	.	.	.
Species group L																													
Eragrostis rigidior	17	30	.	25	.	40	100	80	92	91	92	100	92	93	100	80	83	80	93	60	14	20	.	50	50	100	63	67	100
Dichrostachys cinerea	100	50	46	88	67	80	100	80	100	91	67	89	92	100	100	20	67	100	87	80	100	60	100	75	100	67	38	100	75
Heteropogon contortus	17	30	15	.	.	60	75	100	100	91	100	89	46	57	83	60	83	80	73	20	86	20	.	75	25	67	63	67	100
Aristida canescens	50	10	23	.	.	80	50	.	50	91	75	78	100	43	17	100	92	100	100	100	100	20	40	.	100	100	63	.	25
Melinis repens	.	.	15	13	50	40	25	60	58	82	67	67	15	21	100	20	92	40	67	20	86	40	.	75	100	100	100	100	75
Grewia flava	100	80	92	63	17	100	100	80	67	73	83	100	100	100	33	60	25	60	13	20	29	40	40	50	25	100	.	50	.
Solanum panduriforme	67	.	31	50	83	100	50	20	67	82	17	67	77	79	50	100	83	100	93	60	57	.	20	100	25	67	63	67	75
Lantana rugosa	67	30	69	13	67	100	50	80	83	73	42	89	62	29	50	40	17	40	.	20	86	60	40	100	25	67	.	50	25
Digitaria eriantha	100	70	100	50	.	80	50	80	100	64	100	89	62	64	67	100	100	40	60	100	.	.	.	100	50	33	75	100	100
**Schkuhria pinnata*	100	100	77	100	33	60	75	40	58	91	25	67	62	64	67	100	100	80	93	80	43	20	.	25	50	100	63	17	50
Tephrosia purpurea	67	70	69	75	100	60	25	80	58	64	50	67	46	50	100	.	42	100	73	60	86	20	.	75	100	33	100	67	50
**Tagetes minuta*	33	20	31	13	67	80	75	60	67	18	.	.	15	7	33	60	75	80	67	100	29	20	.	25	.	.	38	83	.
Leucas martinicensis	100	40	54	25	17	100	50	40	25	27	.	56	62	7	.	60	42	100	47	80	29	20	40	.	50	33	63	17	.
Acalypha indica	67	50	31	25	50	60	25	60	75	36	.	.	23	.	.	60	42	60	87	80	86	40	100	100	25	33	38	.	.
Rhus leptodictya	17	.	77	.	.	80	100	80	75	36	58	67	67	21	83	80	8	40	27	20	14	.	40	.	.	67	13	67	50
Commelina africana	17	30	15	38	33	.	25	.	.	36	50	22	.	29	17	60	92	20	80	60	.	.	.	75	50	33	75	33	75
Acacia caffra	17	.	.	.	17	80	100	60	83	36	25	89	23	.	67	100	67	40	80	20	43	.	.	50	.	.	13	50	25
Enneapogon scoparius	17	30	54	13	.	80	50	80	100	46	33	56	46	21	33	20	17	40	27	60	29	80	80	.	.	100	13	.	25
Enneapogon cenchroides	100	30	85	25	50	80	50	100	42	46	25	33	77	43	83	80	42	40	67	60	14	40	.	100	.	67	13	.	.
Phyllanthus incurvus	.	10	8	50	.	40	25	.	8	46	25	78	31	36	.	.	8	20	13	.	14	.	20	100	25	67	25	67	75
Pentarrhinum insipidum	50	20	69	.	33	100	75	80	92	27	50	67	46	57	50	100	42	100	60	.	43	.	.	.	25	67	.	83	.
**Achyranthes aspera*	50	30	62	.	.	40	50	20	8	18	.	22	62	57	17	80	17	100	73	100	71	100	100	100	75	67	25	17	25
**Bidens bipinnata*	83	10	100	.	83	60	75	60	67	9	.	.	46	43	50	100	33	100	93	80	57	40	40	100	75	33	63	100	100
Acacia nilotica	67	30	100	.	83	40	75	100	83	9	50	89	69	50	67	.	8	20	13	.	14	20	60	25	.	67	.	.	75
Euclea undulata	33	.	54	.	.	20	75	60	75	36	8	56	85	14	67	80	17	40	.	20	.	60	60	.	.	33	.	.	50
Euphorbia inaequilatera	17	20	8	25	.	20	50	40	25	55	.	22	23	21	83	40	83	40	93	40	14	.	.	25	.	.	13	17	100
Kohautia amatymbica	.	60	15	38	.	.	25	20	42	46	.	.	23	7	17	.	92	40	60	.	14	.	.	.	.	33	25	17	75
Rhynchosia minima	67	60	92	75	83	100	.	80	100	27	.	11	38	.	50	.	8	60	27	100	.	.	20	25	50	.	.	.	.
Ipomoea obscura	17	20	.	.	17	.	.	.	8	9	75	67	8	50	.	.	42	.	13	.	29	60	.	.	75	.	.	17	.
Hermbstaedtia linearis	17	10	.	.	.	.	.	20	33	.	17	.	23	64	.	.	8	20	.	.	.	.	.	.	.	33	25	.	75

* Alien species

8.3 Description of the vegetation units

Each vegetation unit was described in terms of environmental variables and diagnostic and dominant species. The ten dominant grass species were determined for Vegetation Sub-units 1.1 and 1.2 and Vegetation Units 2 and 3 by looking at the highest percentage cover and abundance of the grass species in Table 8.1. Van Oudtshoorn (2004) assigned categories to each grass species with regard to grazing value, perenniality, plant succession and ecological status. These categories are given for the ten dominant species of each vegetation unit in Figures 8.2 – 8.5. These values may vary between different geographical areas, but they still give a good indication of the general grazing value and veld condition of the respective vegetation units. Vegetation Sub-units 3.1 and 3.2 were not evaluated separately as it was expected that they are fairly similar.

According to Van Oudtshoorn (2004) the grazing value is influenced by how much leaf material is produced, the palatability, nutritional value, digestibility and the ability to recover after grazing. Grazing values for the dominant species in the different vegetation units are given in Figure 8.2.

Plant succession is the progressive succession of plant communities (Van Oudtshoorn, 2004; Bothma, 2006). The successional stages include the pioneer, sub-climax and climax stages as described by Tainton & Hardy (1999); Van Oudtshoorn (2004) and Bothma (2006). See Figure 8.4 for the successional stages of the dominant grass species of the different vegetation units in the CCA. The proportion of pioneer species to climax species gives a good indication of the veld condition. It should however be kept in mind that the climax vegetation is not necessarily the most productive veld condition and that sub-climax vegetation can sometimes yield a higher biomass. (Bothma, 2005).

Another method to determine veld condition is to consider the ecological status of the grass species present in an area (Figure 8.5). The ecological status of grasses refers to the grouping of grass species on the basis of their reaction to different levels of grazing (Van Oudtshoorn, 2004). A decreaser species is a species that is abundant in good veld and decreases with overgrazing or under grazing. Increaser 1 species, increase when the veld is underutilized. Increaser 2 and 3 species increase when the veld is overgrazed in the short- or long term. Increaser 2 species increase because of the disturbance caused by overgrazing; they are mostly pioneer or sub-climax species. Increaser 3 species increase, because they are unpalatable and can compete with grass species that are weakened by overgrazing (Van Oudtshoorn, 2004).

The perenniality of the ten dominant grass species in each vegetation unit is given in Figure 8.3. Annual plants are plants that complete their life cycle from germination to seeding and mortality within one year, while perennials have a life cycle that persists for more than one year (Van Wyk & Malan, 1998). Most areas that are dominated by annuals are more disturbed.

All the species and species groups that will be referred to in the description of the vegetation units can be found in Table 8.1. The relationship between plant communities, land types and vegetation units can be seen in Table 8.2. The vegetation units that were identified in the CCA were compared to the vegetation classes identified by Winterbach (1998) in the North-West Province. In her study, Winterbach (1998) combined 29 studies carried out in the North-West Province into one large data set. None of these studies were done inside the CCA. The vegetation classes distinguished by Winterbach (1998) were very broad and could be compared with the vegetation units of the CCA. The communities identified by other studies that have been carried out in the surrounding areas, were compared to the communities of the CCA and discussed in Chapters 4-7. The latter is not given in this chapter again.

1. *Acacia robusta – Acacia tortilis* Vegetation Unit

This vegetation unit was found on deeper soil than the other two vegetation units. The average soil depth was more than 90 cm. The soil in general was also more clayey with a higher base status, pH, calcium concentration and more bush thickening. The most common soil forms encountered were Hutton, Bainsvlei and Rensburg. This vegetation unit falls into the Dwaalboom Thornveld vegetation type (Mucina & Rutherford, 2006).

This vegetation was mostly characterised by microphyllous tree species, such as *Acacia* species. The diagnostic species of this vegetation unit were found in species group A. They included the tree *Acacia robusta*, the shrub *Asparagus setaceus* and the perennial grass *Bothriochloa insculpta*. The dominant species included the shrub *Grewia flava* (species group L), the tree *Acacia tortilis* (species group A) and the perennial grass *Cymbopogon pospischilii* (species group F).

This vegetation unit was similar to the *Panico maximi – Acacietea tortilis* class identified and described by Winterbach (1998) in the North-West Province. It is further similar to the microphyllous thorny vegetation in warm, dry lowlands vegetation identified by Van der Meulen (1979) and the microphyllous vegetation dominated by *Acacia* species described by Zacharias (1994).

Table 8.2: The relationship between the vegetation units, land types and plant communities.

Vegetation unit	Land type	Community no.
1. *Acacia robusta – Acacia tortilis* Vegetation Unit		
1.1 *Eragrostis curvula – Setaria incrassata* Vegetation Sub-unit	Ae	5.1
	Ae	5.2
	Ea	2.2
	Ea	3.1
	Ea	3.2
	Ea	4
1.2 *Ptycholobium plicatum* subsp. *plicatum - Ziziphus mucronata* Vegetation Sub-unit	Ea	1
	Ea	2.1
	Ae	1.1
	Ae	1.2
	Ae	1.3
	Ae	2
	Ae	3
	Ae	4
2. *Mundulea sericea – Vitex zeyheri* Vegetation Unit	Fa	1
	Fa	2.1
	Fa	2.2
	Fa	3.1
	Fa	3.2
3. *Grewia flavescens – Panicum maximum* Vegetation Unit		
3.1 *Commiphora schimperi – Pappea capensis* Vegetation Sub-unit	Fa	4
	Fb	1
	Fb	7.1
	Fb	7.2
3.2 *Combretum zeyheri – Waltheria indica* Vegetation Sub-unit	Fb	2
	Fb	3
	Fb	4
	Fb	5
	Fb	6.1
	Fb	6.2

1.1 *Eragrostis curvula – Setaria incrassata* Vegetation Sub-unit

The *Acacia robusta – Acacia tortilis* Vegetation Sub-unit was found on foot- and midslopes on vertic clay soil in the Ae and Ea land types. The Rensburg soil form was most often encountered, but also the Arcadia and Willowbrook soil forms. These soil had high calcium content and lime nodules were often found on the soil surface.

According to Van der Meulen (1979), these soil are derived from norite and gabbros and are often found in the landscape depressions. Calcium and magnesium leach from surrounding higher laying soil to these soil, making them more fertile (Stalmans & De Wet, 2003). It had a high base saturation, cation exchange capacity (CEC) and pH, as will be discussed later. Nutrients are not easily leached from clay soil, because of the high CEC (Ashman & Puri, 2005). The grass species found on this vegetation sub-unit consequently are more palatable and nutritious, which can clearly be seen in Figure 8.2. One would expect this to lead to overgrazing, but according to Figures 8.3 – 8.5, Vegetation Sub-unit 1.1 is in the best condition of all the vegetation units. It seems as if this sub-unit is more resilient, but the good condition can also be attributed to better management practices in the past.

A large part of Vegetation Unit 1.1 was found on land belonging to the PPC cement mining company. As explained in previous chapters, this land has not been grazed by cattle for the past 15 years. There was however some grazing and browsing by Impala and Kudu. Impala are mixed grazer-browsers, which means that they eat both grass and tree leaves. Kudu are browsers (Owen-Smith, 1999; Van Hoven, 2006). Grazing has therefore been limited in this area, which explains the good veld condition. In future, care should however be taken to prevent overgrazing. Van Oudtshoorn (2004) stated that the lower laying areas are usually the first to be overgrazed, because the soil is more fertile and the grass more palatable.

It is important to note that dirt roads on these soil are inaccessible under wet conditions, because of its plastic nature. It is very sticky when wet and has the ability to swell and shrink markedly (Stalmans & De Wet, 2003).

The vegetation associated with these soils was quite unique and was characterised by microphyllous trees, such as *Acacia tortillis* and *Acacia karroo*. The diagnostic species for this vegetation sub-unit were the perennial grasses *Setaria incrassata*, *Eragrostis curvula* and *Ischaemum afrum*, the perennial forbs *Crabbea hirsuta* and *Orthosiphon amabilis*, the annual grass *Panicum schinzii* and the tree *Rhus lancea* (species group B). Dominant species included the annual grass *Brachiaria eruciformis* (species group A) and the perennial grasses *Setaria incrassata* and *Ischaemum afrum*.

1.2 *Ptycholobium plicatum* subsp. *plicatum - Ziziphus mucronata* Vegetation Sub-unit

This vegetation sub-unit was found on foot- and midslopes, on deep, sandy loam soil. It was situated mostly in the Ae land type, but two of the eight communities were found in the Ea land type. Vegetation Sub-unit 1.2 had a fairly even distribution of grass species with high, average and low grazing values (Figure 8.2). The perenniality, plant succession and ecological status graphs indicates that this sub-unit was in a worse condition than Vegetation Sub-unit 1.1 (Figures 8.3 – 8.5). This is most likely a result of bad management practises, such as overgrazing.

The diagnostic species for this vegetation sub-unit were the perennial herbs *Ptycholobium plicatum* subsp. *plicatum* and *Aptosimum procumbens*, the perennial grass *Cymbopogon nardus* and the perennial dwarf shrub *Jatropha zeyheri* (species group C). The dominant species included the perennial grass *Eragrostis rigidior*, the tree *Dichrostachys cinerea* and the shrub *Grewia flava* (species group L).

2. *Mundulea sericea – Vitex zeyheri* Vegetation Unit

This vegetation unit was found on shallow, sandy soil on foot- and midslopes. It was situated in the Fa land type and was characterized by more macrophyllous vegetation than Vegetation Unit 1, including *Combretum* species, *Vitex zeyheri* and *Mundulea sericea*. This vegetation unit was found on Mispah soil and fell into the Madikwe Dolomite Bushveld (Mucina & Rutherford, 2006).

Of the ten dominant grass species encountered in the *Mundulea sericea – Vitex zeyheri* Vegetation Unit, five had a low grazing value (Figure 8.2). The soil is easily leached and therefore it was not very fertile, which caused the grass to be less palatable. Some palatable grasses such as *Urochloa mosambicensis* and *Schmidtia pappophoroides* were however also found in this unit. Looking at perenniality and plant succession, one can however see that this vegetation unit was in a somewhat better condition than units 1.2 and 3 (Figure 8.3 and 8.4). There were more perennials and weak perennial and fewer annuals in Vegetation Unit 2 than in Vegetation Sub-unit 1.2 and Vegetation Unit 3 and there were more sub-climax species and fever pioneer species in Vegetation Unit 2 than in Vegetation Sub-unit 1.2 and Vegetation Unit 3. This was most likely also caused by sound management practices, showing how important sound veld management practices are. Bush thickening was not a problem in this management unit and there was less overgrazing than in Vegetation Unit 1. Occasional burning will attract animals.

The diagnostic species for the *Mundulea sericea – Vitex zeyheri* Vegetation Unit were the trees *Vitex zeyheri* and *Mundulea sericea* and the forb *Hermannia stellulata* (species group D). Dominant species included the perennial grass species *Eragrostis rigidior* and *Aristida canescens* and the tree *Dichrostachys cinerea*.

There were similarities between Vegetation Unit 2 and the *Terminalio sericeae – Combretetea apiculati* class described by Winterbach (1998). Vegetation Unit 2 further showed similarities with broad-leaved vegetation dominated by *Combretum* species described by Zacharias (1994).

3. *Grewia flavescens – Panicum maximum* Vegetation Unit

The *Grewia flavescens – Panicum maximum* Vegetation Unit was also found on shallow sandy soil, but unlike Vegetation Unit 2, it was found on mountains, which made it unique and diverse. Vegetation Unit 3 had a high percentage rocks on the soil surface and was mostly found on the Mispah soil form. It was situated in the Fb land type and formed part of the Dwarsberg-Swartruggens Mountain Bushveld described by Mucina & Rutherford (2006). This vegetation unit was also characterized by macrophyllous trees, such as *Combretum* species, *Bridelia mollis* and *Croton gratissimus*. Parts of the Dwarsberg were included in this study, as well as the hills at Ramosibitswana and Tshweneng.

This vegetation unit is very important in terms of aesthetic value and biodiversity. It is diverse and holds a great variety of species that are not found elsewhere in the proposed Heritage Park. The higher heterogeneity in landscape and vegetation composition can accommodate a greater variety of animal species (Van Rooyen, 2006). It is of great importance to conserve this management unit and further studies, especially biodiversity studies will be of great value. This vegetation unit was under-sampled because of limited time and resources and inaccessibility.

It is quite common to find nutrient-poor uplands and nutrient-rich bottomlands, as nutrients leach from upland areas to lowland areas (Scholes, 1990). This phenomenon can also be seen in this study, as Vegetation Unit 3 in general had less fertile soil than the other two vegetation units. Most grazers are attracted to bottomland areas, as the grass is more palatable and because it is more accessible. Overgrazing was not a problem on the mountains, but definitely on the footslopes of the mountains. Bush thickening was also a serious problem on footslopes.

There was an even distribution of grasses with a low, average and high grazing value in Vegetation Unit 3 (Figure 8.2). The ecological status of the grasses in this vegetation unit is poor, if compared to Vegetation Sub-unit 1.1, due to high abundance of Increaser 2 and 3 species (Figure 8.5). Disturbance might be caused by the steep slope and shallow soil. There is however a higher abundance of perennial species in vegetation Unit 3 than in Vegetation Sub-unit 1.2 and Vegetation Unit 2 (Figure 8.3).

The diagnostic species for this vegetation unit included the shrubs *Grewia flavescens* and *Bridelia mollis*, the perennial herb *Polygala sphenoptera* and the annual herb *Commelina benghalensis*, the perennial grass *Andropogon chinensis* and the tree *Croton gratissimus* (species group G). The dominant species were the first two diagnostic species, the perennial grass *Panicum maximum*, the shrub *Grewia monticola* (species group K) and the tree *Dichrostachys cinerea* (species group L).

There were similarities between Vegetation Unit 3 and the *Terminalio sericeae – Combretetea apiculati* class and the *Englerophyto magalismontani – Acacietea caffrae* class described by Winterbach (1998). Vegetation Unit 3 further showed similarities with the mesophyllous vegetation of cool, moist uplands described by Van der Meulen (1979) and the broad-leaved vegetation dominated by *Combretum* species found on koppies described by Zacharias (1994).

3.1 *Commiphora schimperi – Pappea capensis* Vegetation Sub-unit

This vegetation sub-unit was mostly found on northern slopes, with a higher average percentage rocks on the soil surface than Vegetation Sub-unit 3.2. It included one plant community from the Fa land type, which was found on hills and two plant communities from the Fb land type (Table 8.2).

There were no diagnostic species for this vegetation sub-unit. It had species group F in common with Vegetation Units 1 and 2, but lack the species of species groups F and I. The dominant species in this vegetation sub-unit included the trees *Sclerocarya birrea, Pappea capensis* (species group K) and *Dichrostachys cinerea* (species group L).

3.2 *Combretum zeyheri – Waltheria indica* Vegetation Sub-unit

This vegetation sub-unit was mostly found on southern slopes. All the plant communities in this vegetation sub-unit were found in the Fb land type

The diagnostic species of the *Combretum zeyheri – Waltheria indica* Vegetation Sub-unit were found in species group I and they included the trees *Combretum zeyheri*, *Burkea africana*, *Terminalia sericea* and *Canthium mundianum* and the annual herbs *Oldenlandia herbacea* and *Gisekia pharnacioides*. It is further characterized by the absence of the species in species group H. Dominant species included the annual herb *Walteria indica* (species group J) which was present in all the communities and sub-communities in vegetation Sub-unit 3.2 and *Combretum zeyheri* and *Oldenlandia herbacea* (species group I).

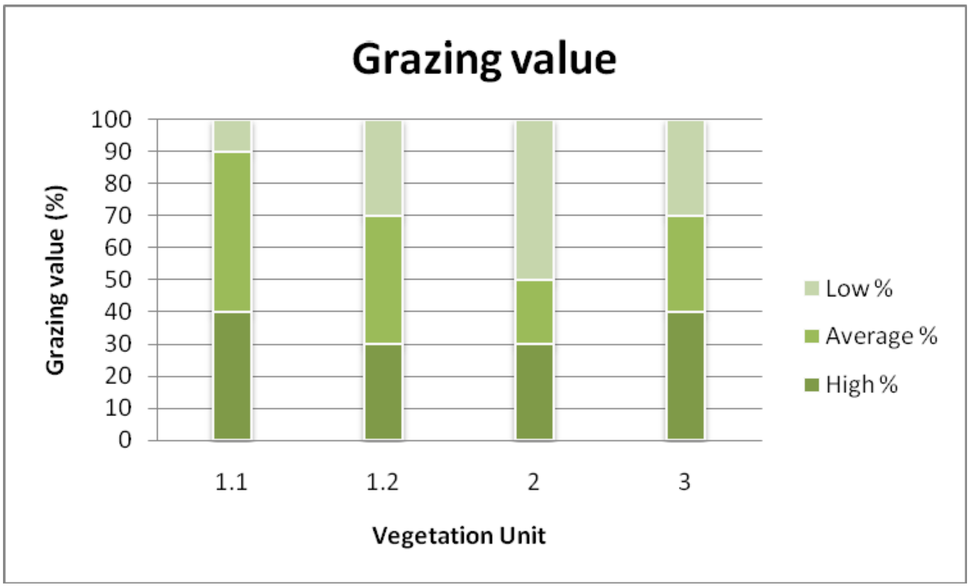

Figure 8.2 Grazing value of the ten most common grass species of the different vegetation units of the CCA of the proposed Heritage Park (According to Van Oudtshoorn, 2004).

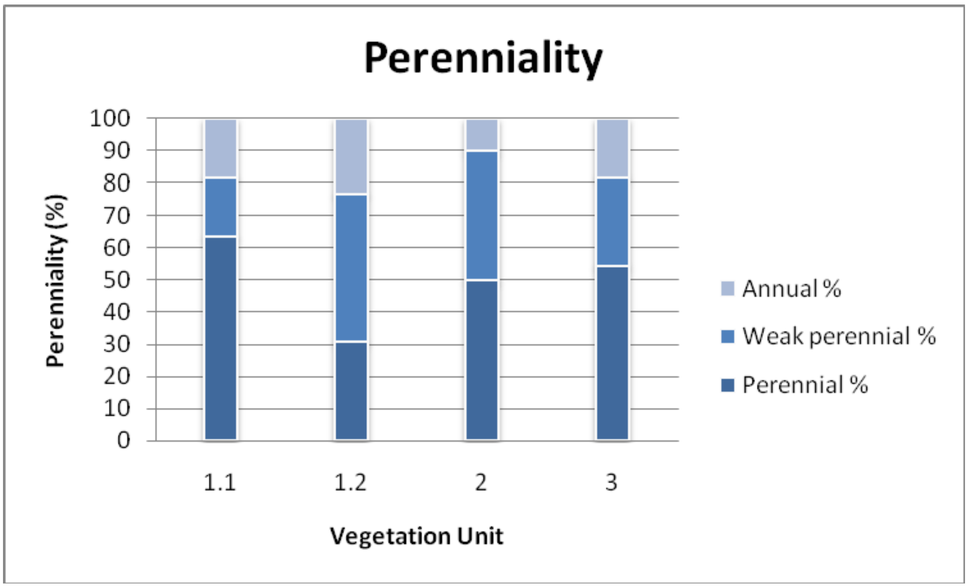

Figure 8.3 Perenniality of the ten most common grass species of the different vegetation units of the CCA of the proposed Heritage Park (According to Van Oudtshoorn, 2004).

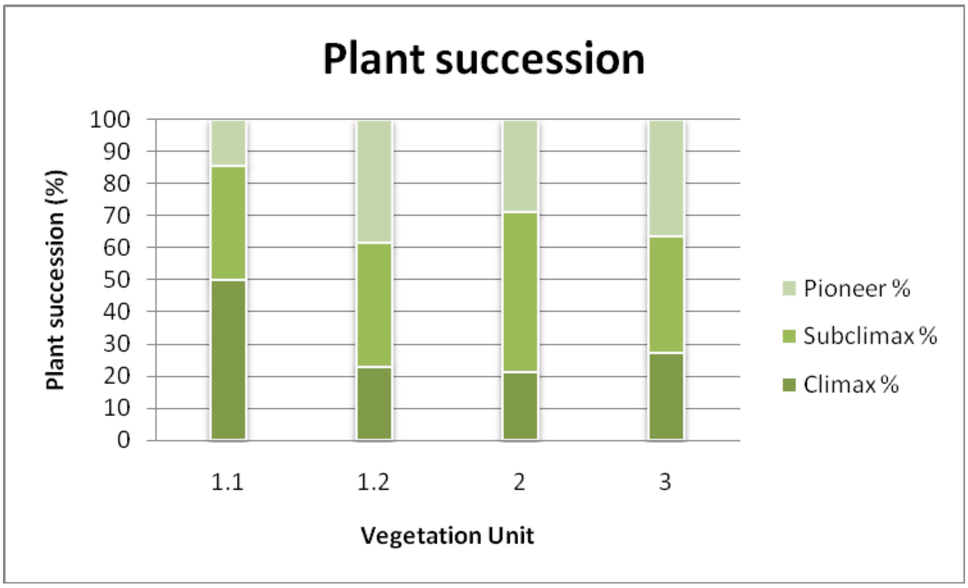

Figure 8.4 Plant succession of the ten most common grass species of the different vegetation units of the CCA of the proposed Heritage Park (According to Van Oudtshoorn, 2004).

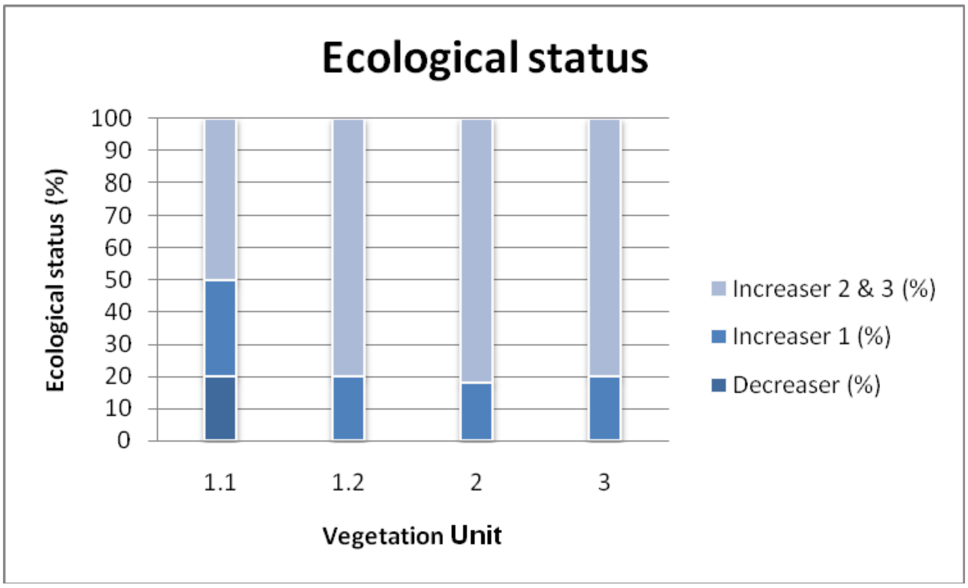

Figure 8.5 Ecological status of the ten most common grass species of the different vegetation units of the CCA of the proposed Heritage Park (According to Van Oudtshoorn, 2004).

8.4. Bush thickening

Bush thickening by *Dichrostachys cinerea* is a serious problem in some parts of the *Acacia robusta – Acacia tortilis* Vegetation Unit (Vegetation Unit 1). There is considerable bush thickening (Figure 8.6) in the northern part of the study area on the land that belongs to the Pretoria Portland Cement Company Limited (PPC) and farms surrounding PPC, on the footslopes of all the mountains and next to roads. This was also observed by Stalmans & De Wet (2003). The most serious instances of soil erosion were at the northern footslope of the Dwarsberg Mountains and at the bottom of the mountain at Ramosibitswana and Tweneng.

Bush thickening and the increase of alien species were also common at artificial watering points.

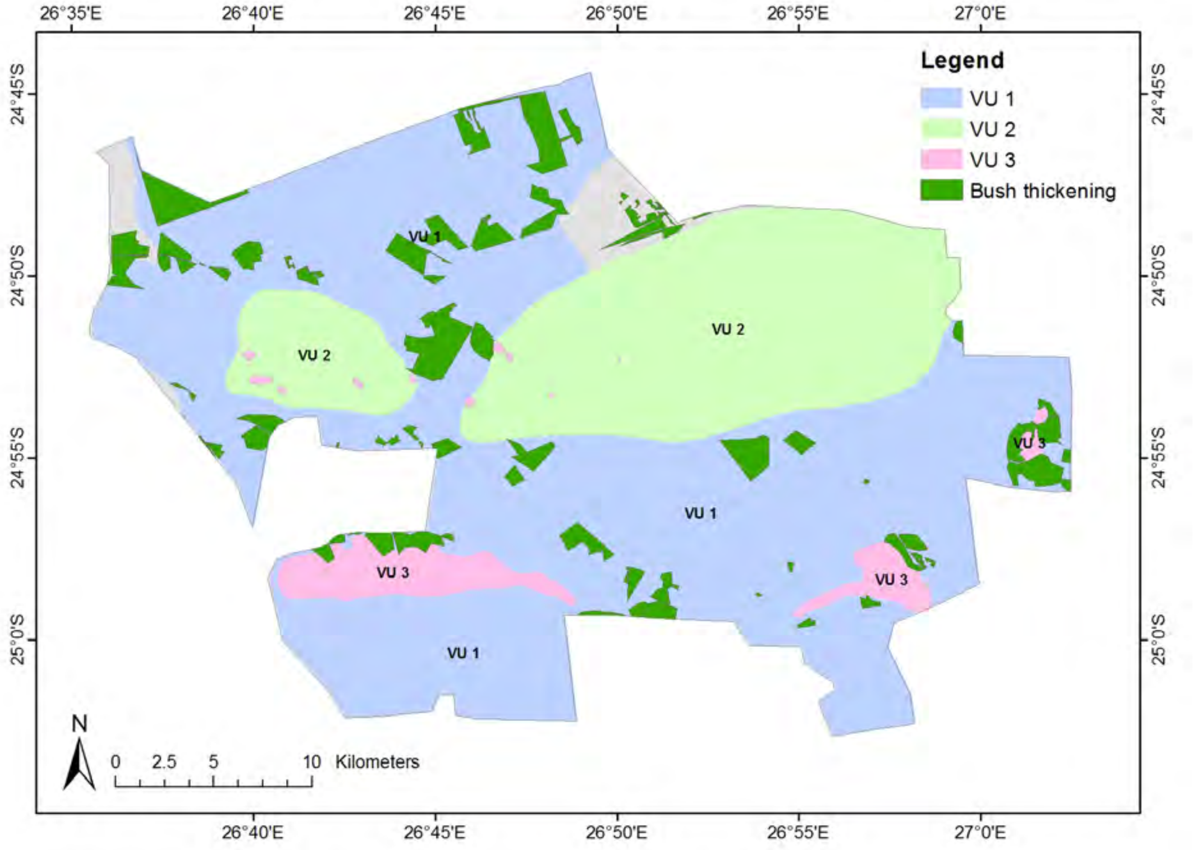

Figure 8.6 Areas with serious bush thickening in the CCA of the proposed Heritage Park.

According to Smit *et al*. (1999) there is a fine competitive balance between the grass and tree layers in the Savanna biome. Several factors can influence this balance to tilt either way. Overgrazing for example puts pressure on the grass layer and therefore tilts the competitive balance in favour of the tree layer. Overgrazing also reduces the fuel load, which prevents hot fires, which would have killed tree seedlings (Smit *et al*., 1999). When fire is excluded, seedlings that would have died get the opportunity to mature and the woody cover increase significantly (Coughenour & Ellis, 1993; Hudak, 1999; Smit *et al*., 1999). Roques *et al.* (2001) confirmed that there is a positive correlation between shrub encroachment (bush thickening) of *Dichrostachys cinerea* and grazing pressure and there is a negative correlation between shrub encroachment and fire frequency. Fire frequency of less than one in every 3 – 4 years, was associated with bush thickening and more than that was associated with decline in shrub cover. Bush thickening is therefore mostly the result of poor grazing management practices, extremely high stocking rates, exclusion of occasional hot fires and the provision of artificial watering points (Smit *et al*., 1999; Skarpe, 1990; Tobler *et al.*, 2003).

Bush thickening does not only cause the decline of grazing capacity, but also reduce visibility and the aesthetic value of an area (Hudak, 1999; Smit *et al*., 1999). If Vegetation Unit 1 is going to be used for game viewing and hunting as proposed by Boonzaaier and Lourens (2002) the bush thickening problem will have to be addressed. This can be done by following a more natural or passive approach, such as reducing the number of grazers and introducing more browsers to the area which will both relieve the pressure on the grass layer and help to control the tree layer (Hudak, 1999; Smit *et al*., 1999). Reintroducing regular fires will also greatly contribute to solving the problem. In some cases a more active approach, such as mechanical bush thinning and applying arboricides will however be necessary. The land owned by PPC serves as a good example of an area where bush thickening has been addressed. In some areas active bush thinning programmes have been applied. As discussed in Chapter 4, there was little overgrazing, compaction and erosion after 15 years of limited grazing in these areas. The areas where no active restoration practices have been applied, however still had serious bush thickening. A combination of passive and active approaches has been successfully used in Madikwe Game Reserve (Madikwe Development Task Team, 1994; Hudak, 1999). Trees that have been removed during mechanical bush thinning can be used for brush packing in areas with serious soil erosion (Smit *et al*., 1999). At PPC, people from the local communities were employed in bush thinning projects where they sell the wood to generate an income. More projects such as these should be initiated in the rest of the CCA, as this also contributed to community development and job creation. It is essential to also follow a post-thinning management programme to keep the area open.

Reducing the pressure on the grass layer will also help combat soil erosion, as a denser grass layer will prevent soil from being washed away by rain water (Snyman, 1999). Brush packing will also help to stabilize the soil and to create favourable microhabitats for grass seeds to germinate. Ripping and overseeding might be necessary where soil has been seriously compacted to stimulate revegetation and brush packing (Snyman, 1999). Erosion gullies can be stabilized by building mechanical structures inside, such as earth, concrete, brick or stone structures (Snyman, 1999). An in-depth study has to be carried out first to determine the extent of soil erosion and what the best approach will be to solve the problem.

8.5 Management of old cultivated fields

Vegetation Unit 1 contains old cultivated fields, as the soil is deep enough for crop production (see Figure 8.7 for the location of old cultivated fields in the Central Corridor Area). The focus of this study was primarily on natural vegetation. Old cultivated fields do however also play an important role in the environment in terms of grazing for example and therefore six relevés were completed on such fields. A few of the cultivated fields are still in use, but most of them have been abandoned for several years. The vegetation of the old cultivated fields on vertic clay soil has been classified as the *Sorghum versicolor - Bothriochloa insculpta* Community (Community

4 of the Ea land type). No surveys were however carried out in old cultivated fields that were found on non-vertic clay soil in the CCA.

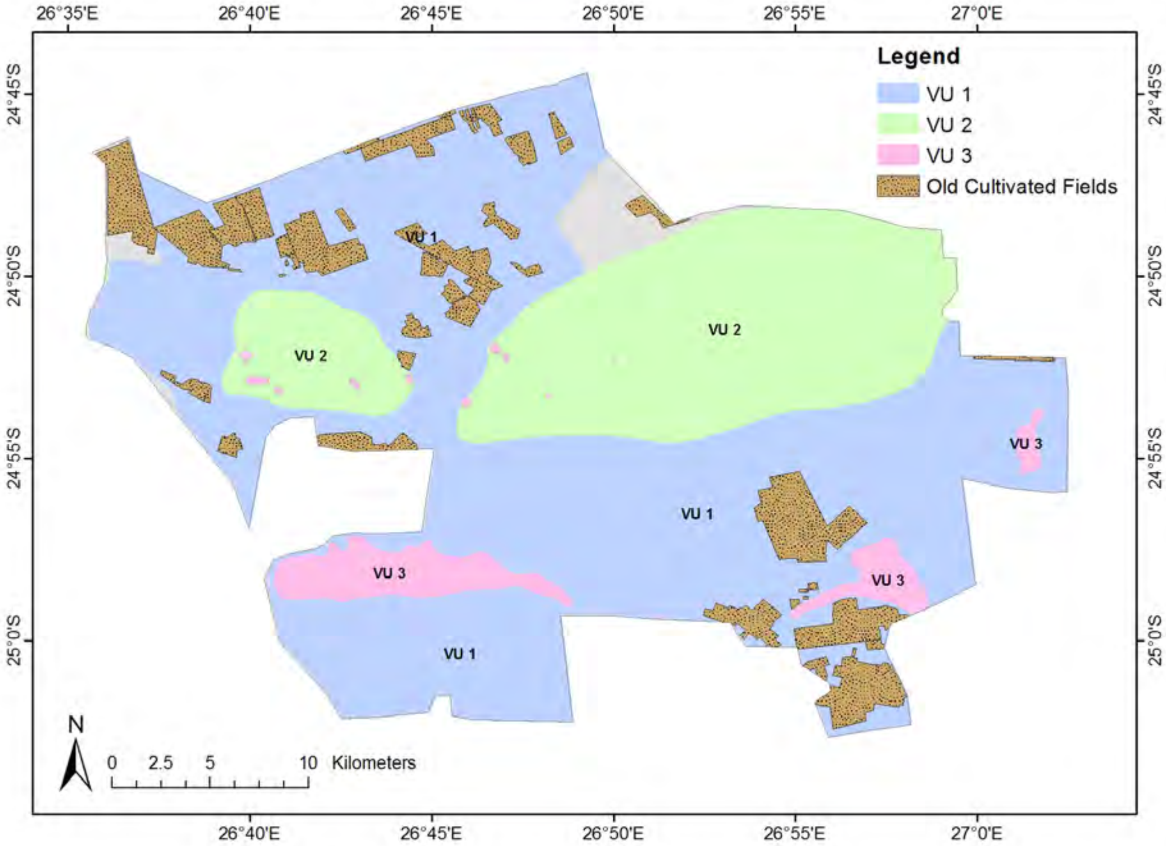

Figure 8.7 Map indicating the position of old cultivated fields in the CCA in the proposed Heritage Park. Note that it is limited to the *Acacia robusta – Acacia tortilis* Vegetation Unit (Vegetation Unit 1).

If one considers how successful abandoned cultivated fields have recovered in the CCA without considerable intervention, it can be concluded that cultivated fields that are still in use will probably recover by themselves over the years once abandoned. The recovery process can however be enhanced by sowing *Cenchrus ciliaris* and other grass species, which have a high grazing value (Zacharias, 1994; Van Oudtshoorn, 2004).

Old cultivated fields can be very beneficial for the proposed Heritage Park, as it tends to be an outstanding source of grazing. Grass production is favoured by the removal of tree species. It is also advantageous for game viewing as such fields are more open. As succession occurs, this favourable condition is lost and bush thickening might occur. In some cases bush thickening is already a problem in old cultivated fields. The management plan of the Madikwe Game Reserve stated that the open vegetation units on the old cultivated fields should remain open as it provides a key grazing and game viewing resource (Stalmans, 2007). This might also be a good option for the management of old cultivated fields in the proposed Heritage Park.

8.6 Tourism zones proposed by Boonzaaier & Lourens (2002)

Four tourism zones have been identified in the proposed Heritage Park by Boonzaaier & Lourens (2002), namely the recreation zone, breeding zone, resource use zone and the game viewing zone.

The recreation zone contains features such as the Molatedi Dam, the Marico River and a part of the Dwarsberg mountain range, which are aesthetically very attractive. It falls into the Madikwe Game Reserve Expansion Area (MGREA) and activities planned for this zone include fishing, water sport and picnicking (Boonzaaier & Lourens, 2002).

The breeding zone has a lower aesthetic value than the other zones. The proposal was therefore to develop this area into a breeding centre for rare game species, such as rhino, buffalo, roan and sable (Boonzaaier & Lourens, 2002). This zone is located in the northern part of the Central Corridor Area and falls into the *Acacia robusta* – *Acacia tortilis* Vegetation Unit (Vegetation Unit 1).

The resource use zone does not have such a high potential for game viewing. It would however be sufficient for hunting. According to Boonzaaier & Lourens (2002) this is a very lucrative sector and it would be foolish not to cater for this market. This zone is located in the eastern part of the Central Corridor Area and the northern part of the Pilanesberg National Park Expansion Area (PNPEA) and it falls mostly into the *Acacia robusta* – *Acacia tortilis* and *Mundulea sericea* – *Vitex zeyheri* Vegetation Units (Vegetation Units 1 and 2).

The game viewing zone has a high aesthetic value and has the potential to be developed as a game viewing area. Most of the proposed Heritage Park falls into this zone and in the Central Corridor Area (Boonzaaier & Lourens, 2002). All three described vegetation types were found in the game viewing zone.

Considering the vegetation classification in the Central Corridor Area, the implementation of these tourism zones should be feasible, as long as these areas are properly managed and not overstocked.

8.7 Ordination

A Correspondence Analysis (CA) ordination (Figure 8.8) was carried out to determine the correlations between the species and the environmental data of the plant communities from the different vegetation units. A CA ordination is an indirect ordination in which the distribution of the samples or communities in this case, is influenced only by species composition. Environmental variables are then overlaid. Quantitative environmental variables, such as soil depth and slope were indicated by arrows, which reflected certain gradients.

In this CA ordination (Figure 8.8) it can be seen that the species composition of the respective vegetation units and sub-vegetation units were unique as they formed distinct clusters. Ordination axis one showed a strong positive correlation with soil depth (correlation coefficient of 0.72) and strong negative correlations with percentage rocks on the soil surface and slope with correlation coefficients of -0.81 and -0.80 respectively (Table 8.3). From this it can be concluded that the *Eragrostis curvula – Setaria incrassata* Vegetation Sub-unit (Vegetation Sub-unit 1.1) was found on deeper soil than the other vegetation units. The *Ptycholobium plicatum* subsp. *plicatum - Ziziphus mucronata* Vegetation Sub-unit (Vegetation Sub-unit 1.2) and the *Mundulea sericea – Vitex zeyheri* Vegetation Unit (Vegetation Unit 2) were further found on deeper soil than the *Grewia flavescens – Panicum maximum* Vegetation Unit (Vegetation Unit 3).

Vegetation Unit 3 was found on a steeper slope with a higher percentage rocks on the soil surface than Vegetation Units 1 and 2. Base saturation, pH and bush thickening all had positive correlations with the first ordination axis with correlation coefficients of 0.54, 0.57 and 0.60 respectively (Table 8.3). This indicates that the *Acacia robusta – Acacia tortilis* Vegetation Unit (Vegetation Unit 1) was found on soil with the highest base saturation and pH of the three vegetation units and that bush thickening was also the highest in Vegetation Unit 1.

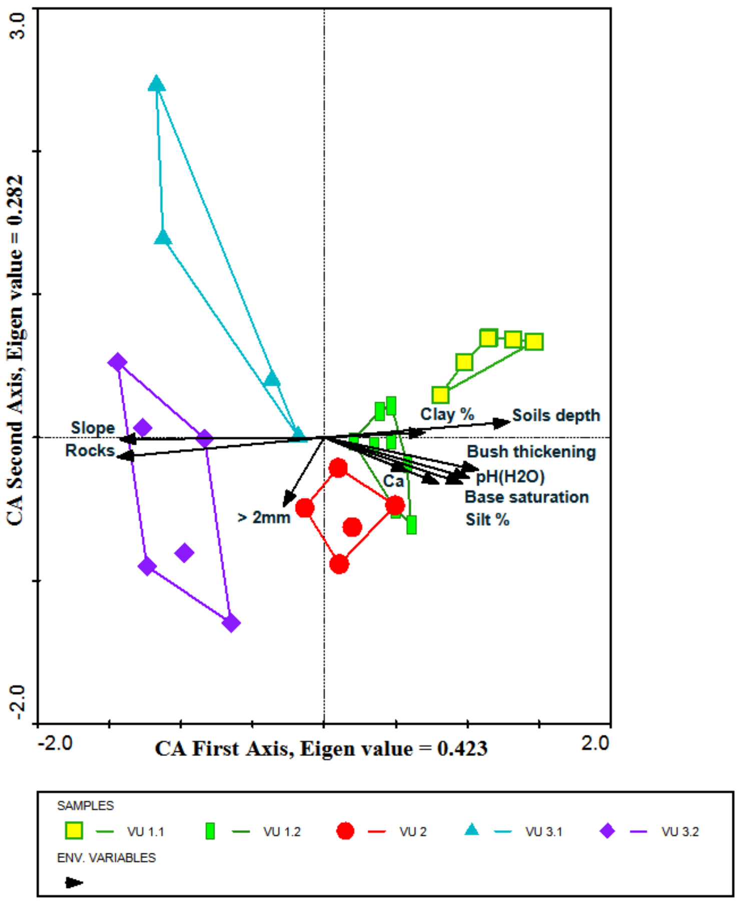

Figure 8.8 CA ordination biplot showing the communities and sub-communities in the different vegetation units in the CCA of the proposed Heritage Park and the role that environmental variables played in their distribution. The names of the vegetation units are as follows: the *Acacia robusta – Acacia tortilis* Vegetation Unit (1): the *Eragrostis curvula – Setaria incrassata* Vegetation Sub-unit (1.1), the *Ptycholobium plicatum* subsp. *plicatum - Ziziphus mucronata* Vegetation Sub-unit (1.2), the *Mundulea sericea – Vitex zeyheri* Vegetation Unit (2), the *Grewia flavescens – Panicum maximum* Vegetation Unit (3): the *Commiphora schimperi – Pappea capensis* Vegetation Sub-unit (3.1) and the *Combretum zeyheri – Waltheria indica* Vegetation Sub-unit (3.2).

Table 8.3 Correlation coefficients of the environmental factors of Figure 8.8.

Environmental Factor	Ordination Axis 1	Ordination Axis 2
Calcium	0.3258	-0.1483
pH (H_2O)	0.5670	-0.1760
Base saturation	0.5402	-0.1997
Particles >2mm	-0.1587	-0.2984
Silt %	0.4463	-0.2001
Clay %	0.3927	0.0203
Soil depth	0.7233	0.0660
Bush thickening	0.6015	-0.1409
Rocks	-0.8075	-0.0855
Slope	-0.7993	-0.0082

8.8 Conclusion

Three main vegetation units were identified in the study area. They correlated with the vegetation types described by Mucina & Rutherford (2006) and also to a great extent with the land types (Land Type Survey Staff, 1988). The Ae and Ea land types were however represented by one vegetation unit, the *Acacia robusta – Acacia tortilis* Vegetation Unit (Vegetation Unit 1), which was found on deep soil. This vegetation unit had more microphyllous trees, such as *Acacia* species. It was divided into two vegetation sub-unit: the first sub-unit was characterized by very clayey (vertic) soil and the second sub-unit by more sandy soil. The *Mundulea sericea – Vitex zeyheri* Vegetation Unit (Vegetation Unit 2) was found on shallow, sandy soil on plains and it occurs in the Fa land type. The *Grewia flavescens – Panicum maximum* Vegetation Unit (Vegetation Unit 3) was also found on shallow sandy soil on mountains and hills and it occurs in the Fb land type, with one exception, that is the hills of the Fa land type. The last two vegetation units had more macrophyllous trees.

The grazing value, perenniality, plant succession and ecological status for the ten dominant grass species in each vegetation unit were discussed. Vegetation Sub-unit 1.1 had more palatable grasses than the other vegetation units, because it was found on the most fertile soil of all the vegetation units. This vegetation sub-unit was also in a good condition, based on perenniality, plant succession and ecological status of the ten dominant grass species found in this vegetation sub-unit. Overgrazing and bush thickening are problems in Vegetation Unit 1. The dominant grass species found in Vegetation Units 1.2 to 3 are less palatable and the veld condition is poorer, mainly due to bad management practices in the past. Further studies are essential for Vegetation Unit 3, as this unit had very high species diversity, but was most likely under-sampled due to the rugged terrain.

Bush thickening is a problem in Vegetation Unit 1 and has to be addressed. Old cultivated fields were also found in Vegetation Unit 1. Tourism zones as proposed by Boonzaaier & Lourens (2002) were discussed shortly.

Chapter 9

Integration of plant communities in the larger Heritage Park

9.1 Introduction

The proposed Heritage Park consists of Madikwe Game Reserve, Pilanesberg National Park and the corridor that links them, as was discussed earlier. The corridor was further divided into three parts namely, the Madikwe Game Reserve Expansion Area (MGREA), the Pilanesberg National Park Expansion Area (PNPEA) and the Central Corridor Area (CCA) (Figure 9.1). The soil and vegetation of MGREA and PNPEA were surveyed by Stalmans & De Wet (2003), who also integrated their findings successfully with the vegetation of Madikwe as described by Zacharias (1994). The vegetation of Pilanesberg was however not integrated with the study from Stalmans & De Wet (2003), as a soil map was not available for Pilanesberg at that stage and their vegetation units were mainly based on soil units. It was therefore important to attempt to integrate the vegetation data of the study done by Stalmans & De Wet (2003) with this study done in the CCA to get an overview of the vegetation of the greater Heritage Park, especially the corridor area.

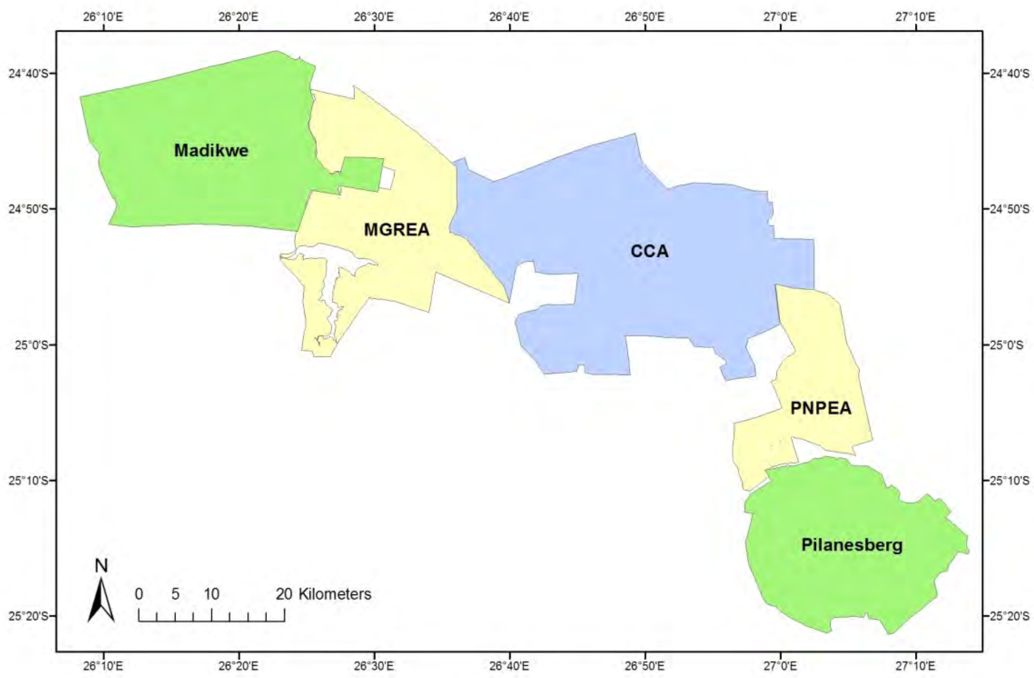

Figure 9.1 Location of the Central Corridor Area (CCA) (shown in blue), within the larger Heritage Park. The Madikwe Game Reserve and Pilanesberg National Park are shown in green and the Madikwe Game Reserve Expansion Area (MGREA) and Pilanesberg National Park Expansion Area (PNPEA) are shown in yellow.

9.2 Plant communities and vegetation units of the Central Corridor Area (CCA)

In Chapters 4-7 maps were given for the plant communities of the respective land types (Figures 4.1, 5.1, 6.1 and 7.1). Figure 9.2 is a combination of the plant communities from all the land types and Table 9.1 explains the legend to the map. In Chapter 8 a map was given for the vegetation units (Figure 8.1), as well as a synthesis of the information of all the plant communities.

9.3 Aims and approaches followed to describe plant communities in the Expansion Areas (MGREA & PNPEA)

The aims of the study of MGREAE and PNPEA (Stalmans & De Wet, 2003) were to:

1) understand the environmental determinants of vegetation and soil;
2) identify and describe individual plant communities and soil forms;
3) combine these into habitat units;
4) give guidelines for management and development for the different habitat units, and
5) to integrate newly generated information with existing data on the Pilanesberg National Park and Madikwe Game Reserve.

Stalmans & De Wet (2003) stated that "the emphasis was less on academically detailed and 'correct' descriptions and maps but more on the user-friendliness, compatibility with existing information and applicability for development planning". Plant communities were classified in such a way that it is identifiable in the field by an observer who is not necessarily a trained botanist. A total of 178 plots of 40 x 40 m, where only grass and tree species were recorded, were surveyed by Stalmans & De Wet (2003). The structural properties of each plot were described according to Edward's (1983) structural classes. Cover and height of the different layers were described and environmental variables were recorded. The results were analysed and presented by classification and ordinations (Stalmans & De Wet, 2003).

9.4 Challenges encountered with the integration of plant communities described in the CCA, MGREA and PNPEA

Several difficulties were encountered in comparing the study of Stalmans & De Wet (2003) with the CCA study:

- Different approaches were followed. Stalmans & De Wet (2003) followed a semi-quantitative, less scientific approach, while a scientifically acknowledged, more thorough approach (the Braun Blanquet approach, as explained in Chapters 1 and 3) was followed for the CCA study.
- Stalmans & De Wet (2003) recorded only grass and tree species, while all growth forms were recorded in the CCA.

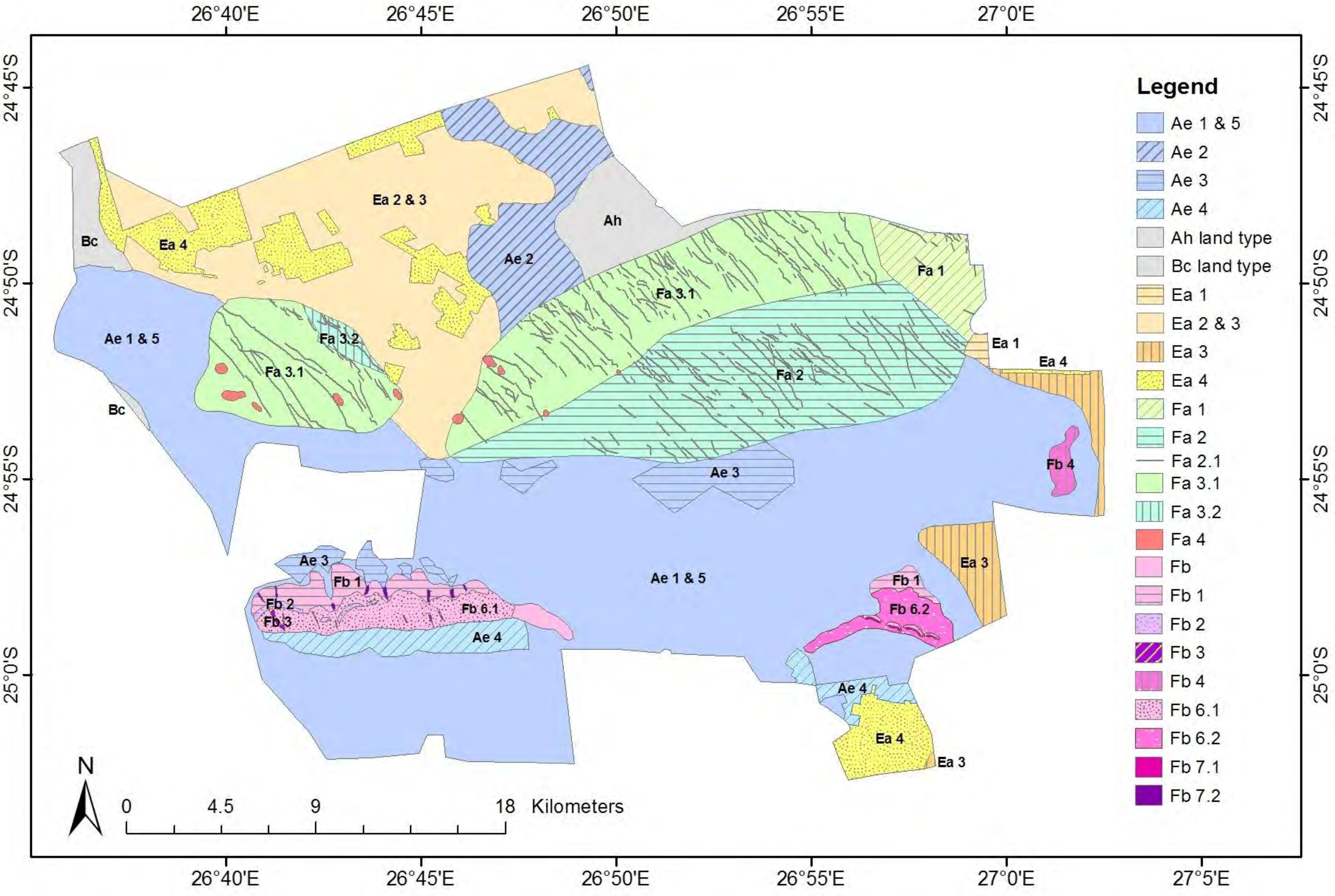

Figure 9.2 Map showing the plant communities of all the land types of the Central Corridor Area of the proposed Heritage Park.

Table 9.1 Explanation of the legend in Figure 9.2: Community numbers and names for each land type.

Ae 1	*Aristida congesta* subsp*. barbicollis – Acacia tortilis* Community
Ae 2	*Combretum imberbe – Heteropogon contortus* Community
Ae 3	*Euclea undulata – Acacia tortilis* Community
Ae 4	*Acacia erioloba – Panicum maximum* Community
Ae 5	*Brachiaria eruciformis – Acacia tortilis* Community
Ah	Not surveyed due to limited surface area covered by this land type
Bc	Not surveyed due to limited surface area covered by this land type
Ea 1	*Peltophorum africanum* - *Urochloa mosambicensis* Community
Ea 2	*Melhania virescens* - *Tarchonanthus camphoratus* Community
Ea 3	*Ischaemum afrum* - *Brachiaria eruciformis* Community
Ea 4	*Sorghum versicolor* - *Bothriochloa insculpta* Community
Fa 1	*Lippia javanica* - *Vitex zeyheri* Community
Fa 2	*Tarchonanthus camphoratus* - *Acacia caffra* Community
Fa 2.1	*Acacia karroo* - *Acacia caffra* Sub-community
Fa 3.1	*Clerodendrum suffruticosum* var. *suffruticosum* - *Sclerocarya birrea* Sub-community
Fa 3.2	*Monsonia angustifolia* - *Dichrostachys cinerea* Sub-community
Fa 4	*Pappea capensis* - *Kirkia wilmsii* Community
Fb 1	*Monsonia angustifolia* - *Combretum apiculatum* Community
Fb 2	*Sphedamnocarpus pruriens* - *Terminalia sericea* Community
Fb 3	*Enneapogon cenchroides* - *Peltophorum africanum* Community
Fb 4	*Acacia mellifera* - *Bridelia mollis* Community
Fb 5	Were not indicated on the map due to its limited and patchy distribution
Fb 6.1	*Gomphocarpus fruticosus* - *Combretum molle* Sub-community
Fb 6.2	*Eragrostis biflora* - *Burkea africana* Sub-community
Fb 7.1	*Pouzolzia mixta* - *Croton gratissimus* Sub-community
Fb 7.2	*Abutilon ramosum* - *Pappea capensis* Sub-community

- Only approximately 15 species were listed for each community described by Stalmans & De Wet (2003) and no distinction was made between dominant and diagnostic species. During the study of the CCA an average of 51 species per relevé and 142 per community was recorded in the CCA, all species were given in tables and diagnostic and dominant species were given in the description of each community.
- The plant communities identified by Stalmans & De Wet (2003) were not mapped individually as they occurred in a fine-scaled mosaic. Broader units were mapped, sometimes including several plant communities and some of the communities were

found in several map units. Map units were mainly based on soil patterns. In this study, individual plant communities were mapped for the CCA as far as possible.

It was therefore a challenge to compare two studies that followed these different approaches, since the end product was completely different. In the study carried out in the CCA, the forbs made up almost half of the species in all the land types, while forbs were not considered by Stalmans & De Wet (2003). It is however essential to include forbs when classifying the vegetation as they make up a large part of the species diversity. If the aim of any study is to get an inventory of the plants in the area for conservation purposes, a complete floristic composition is necessary and taking only grasses and trees into consideration will result in incomplete datasets and results. If, on the other hand, the purpose of the study would be to only get an idea of the grazing and browsing capacity of the area, it would be adequate to only consider grass and tree species, as forbs are generally not grazed or browsed. As one of the main goals of the proposed Heritage Park includes conservation of the area, it is of the utmost importance to include all the plants in the study, as this data can be used to identify biodiversity hotspots that should be protected.

Communities from different studies can also not be compared effectively if both studies do not identify diagnostic species, as these species differentiate plant communities from one another (Dengler *et al.*, 2008). Dominant species given for the communities of the Expansion Areas by Stalmans & De Wet (2003) were often found in most of the communities classified for the CCA or in an entire land type. It therefore did not give a good indication of how the communities from the different studies could be integrated as the species that made them unique was unknown.

Only the comparison of broader units was possible and in some cases there were similarities between specific communities from the different studies. Some map units could be integrated, although it was not possible for all the map units.

9.5 Comparison of plant communities and vegetation units identified and described in CCA, MGREA and PNPEA

Stalmans & De Wet (2003) found that the environmental factor that had the greatest influence on the vegetation of the MGREA was the availability of water. The vegetation found next to water bodies was the most unique in terms of species composition. The Molatedi Dam, Marico River and other drainage lines are located in the MGREA. In the PNPEA, this was however not the case, as no large water bodies was present and the vegetation next to seasonal drainage lines had more affinities to the surrounding vegetation.

The vegetation of the PNPEA was divided into three groups, namely *Acacia*-dominated communities on less clayey soil, *Acacia*-dominated communities on heavy clayey soil (turf soil) and broad-leaved communities found on rocky slopes and outcrops.

As no prominent water bodies were found in the Central Corridor Area, the availability of moisture did not have such a significant impact on the vegetation. It was rather the clay percentage and soil depth that had the greatest influence on the composition and distribution of plant communities.

Factors such as soil characteristics and position in the landscape often gave a better indication of how the studies could be integrated, rather than dominant plant species. The first step in comparing the two studies, was to determine which of the communities from the MGREA and PNPEA were similar to the broad vegetation units identified and described in the CCA (Table 9.2). The second step was to compare the communities from the MGREA and PNPEA with specific communities identified and described in the CCA (Table 9.2). In many cases a specific comparable community could not be found, but the comparison with the vegetation units were generally more successful. Important environmental variables were mentioned in the applicable vegetation units.

Table 9.2 Comparison of the vegetation from the Madikwe Game Reserve Expansion Area (MGREA), Pilanesberg National Park Expansion Area (PNPEA) and the Central Corridor Area (CCA).

Vegetation unit (CCA)	**Community (MGREA & PNPEA)**	**Most similar community (CCA)**	**Environmental variables**
Vegetation Unit 1: *Acacia robusta – Acacia tortilis* Vegetation Unit	MGREA community 4: *Acacia karroo- Eragrostis chloromelas* closed woodland	–	Deeper soil, clay percentage varying from 3.6 % to 47 % in the CCA
Vegetation Sub-unit 1.1: *Eragrostis curvula – Setaria incrassata* Vegetation Sub-unit	MGREA community 5: *Acacia karroo – Panicum coloratum* woodland	Ae community 5.2: *Aspilia mossambicensis – Acacia tortilis* Sub-community	Vertic clay soil (with an average clay percentage of 39 % in the CCA)

Vegetation unit (CCA)	Community (MGREA & PNPEA)	Most similar community (CCA)	Environmental variables
Vegetation Sub-unit 1.1: *Eragrostis curvula – Setaria incrassata* Vegetation Sub-unit	PNPEA community 7: *Acacia tortilis – Ischaemum afrum* low open woodland	–	Vertic clay soil
	PNPEA community 8: *Acacia tortilis – Cynodon dactylon* shrubland	Ea community 4: *Sorghum versicolor - Bothriochloa insculpta* Community	Old cultivated lands on vertic clay soil
	PNPEA community 9: *Acacia karroo – Dichantium annulatum* open woodland	–	Vertic clay soil
Vegetation Sub-unit 1.2: *Ptycholobium plicatum* subsp. *plicatum - Ziziphus mucronata* Vegetation Sub-unit	PNPEA community 2: *Acacia karroo – Cymbopogon plurinodis (C. pospischilii)* thicket	–	Deep soil, less clayey than Vegetation Unit 1.1 (Average clay percentage 19 % for the CCA)
	PNPEA community 3: *Acacia tortilis – Eragrostis rigidior* woodland	–	Deep soil, less clayey than Vegetation Unit 1.1
	MGREA community 6: *Acacia mellifera - Eragrostis rigidior* closed shrubland	Ae community 3C: *Euclea undulata – Acacia tortilis* Community	Less clayey soil than sub-Vegetation Unit 1.1 Heavily grazed, degraded, soil erosion and bush thickening

Vegetation unit (CCA)	**Community (MGREA & PNPEA)**	**Most similar community (CCA)**	**Environmental variables**
Vegetation Sub-unit 1.2: *Ptycholobium plicatum* subsp. *plicatum - Ziziphus mucronata* Vegetation Sub-unit	MGREA community 7: *Acacia tortilis - Bothriochloa insculpta* shrubland	Ae community 3B: *Euclea undulata – Acacia tortilis* Community	Deep sandy loam soil
	MGREA community 8: *Acacia tortilis – Eragrostis rigidior* thicket	–	Found on granites
	MGREA community 13: *Acacia burkei – Panicum maximum* woodland	Ae community 4: *Acacia erioloba – Panicum maximum* Community	Sandy soil on the southern footslope of the Dwarsberg
	PNPEA community 4: *Dichrostachys cinerea – Panicum maximum* thicket	–	Deep sandy loam soil
Vegetation Unit 2: *Mundulea sericea – Vitex zeyheri* Vegetation Unit	MGREA community 9: *Combretum imberbe – Eragrostis lehmanniana* woodland	–	Fa land type, shallow sandy soil with an average clay percentage of 6.3 % for the CCA
	MGREA community 16: *Combretum apiculatum – Heteropogon contortus* woodland	–	Fa land type, shallow sandy soil
Vegetation Unit 3: *Grewia flavescens – Panicum maximum* Vegetation Unit	MGREA community 12: *Spirostachys africana – Croton gratissimus* woodland	Fb community 7: *Spirostachys africana - Panicum maximum* Community	Fb land type, mountains, northern slopes

Vegetation unit (CCA)	**Community (MGREA & PNPEA)**	**Most similar community (CCA)**	**Environmental variables**
Vegetation Unit 3: *Grewia flavescens – Panicum maximum* Vegetation Unit	MGREA community 13: *Acacia burkei – Panicum maximum* woodland	–	Fb land type, mountains, northern and western slopes
	MGREA community 14: *Croton gratissimus - Eragrostis lehmanniana* bushland	Fb community 6: *Bulbostylis hispidula* var. *pyriformis - Combretum zeyheri* Community	Fb land type, mountains, southern slopes
	MGREA community 15: *Dichrostachys cinerea – Acacia erubescens* thicket	–	Fb land type, northern footslopes of mountains
	MGREA community 17: *Faurea saligna – Themeda triandra* woodland	–	Fb land type, high parts of the Dwarsberg Mountains, southern slopes
	PNPEA community 11: *Croton gratissimus – Combretum molle* woodland	Fb communities 4 and 7: 4. *Acacia mellifera - Bridelia mollis* Community 7. *Spirostachys africana - Panicum maximum* Community	Fb land type, mountains
	PNPEA community 12: *Schizachyrium sanguineum – Loudetia* shrubland	Fb community 6: *Bulbostylis hispidula* var. *pyriformis - Combretum zeyheri* Community	Fb land type, mountains

Vegetation unit (CCA)	Community (MGREA & PNPEA)	Most similar community (CCA)	Environmental variables
Vegetation Unit 3: *Grewia flavescens – Panicum maximum* Vegetation Unit	PNPEA community 13: *Acacia caffra – Chrysopogon serrulatus*	Fb community 3: *Enneapogon cenchroides - Peltophorum africanum* Community	Fb land type, mountains, southern slopes

Some communities that were described by Stalmans & De Wet (2003) were not found in the Central Corridor Area, due to environmental differences, such as the presence of water bodies in the MGREA, and the absence thereof in the CCA. These communities are listed below:

- MGREA community 1: *Gomphrena celocioides – Cynodon dactylon* grassland, found along the banks of the Molatedi Dam between the low water mark and the flood level.
- MGREA community 2: *Combretum erythrophyllum – Rhus lancea* woodland, found along the Marico River.
- MGREA community 3: *Ziziphus mucronata – Acacia karroo* closed woodland, found along smaller drainage lines.
- MGREA community 10: *Acacia tortilis – Urochloa mosambicensis* shrubland, on old lands on shale.
- MGREA community 11: *Acacia tortilis – Cenchrus ciliaris* shrubland, on old lands on deep sandy clay loams.
- PNPEA community 1: *Acacia karroo – Ziziphus mucronata* closed woodland, found along seasonal streams.
- PNPEA community 5: *Spirostachys africana – Boscia foetida* thicket, found on the footslope ecotones of the Pilanesberg mountains, that are characterised by water flows from the higher mountainous areas
- PNPEA community 6: *Acacia tortilis –Chloris gayana* shrubland, found on old lands on the transition between Hutton and Glenrosa soil to the vertic clays of the Arcadia form.
- PNPEA community 10: *Combretum erythrophyllum – Bothriochloa insculpta* woodland, found along drainage lines on the Arcadia soil form.

The comparison between CCA, MGREA and PNPEA on plant community level was therefore greatly unsuccessful. Only eight of the 29 communities and sub-communities identified in the CCA were somewhat similar to some of the communities identified and described by Stalmans & De Wet (2003). For reasons described earlier it could however not be said that any of these communities were similar, as too little is known of the communities from the Expansion Areas as described by Stalmans & De Wet (2003).

9.6 Integration of map units

As discussed earlier, Stalmans & De Wet (2003) did not map plant communities individually. They mapped broader units and in some cases a community was found in more than one unit, as map units were based on soil patterns as well as satellite images.

Only four of the map units given by Stalmans & De Wet (2003) could be integrated with communities from the CCA and two of their map units could be integrated with land types in the CCA. These integrated units are given in Figure 9.3 and explained in Table 9.3.

9.7 Conclusion

The integration of vegetation classifications from the Expansion Areas and the Central Corridor Area (CCA) was challenging as different approaches were followed for the two studies. Some broad units could however be compared and similarities between communities from the respective studies were noted. Twenty three of the 32 communities identified and described by Stalmans & De Wet (2003) showed similarities to vegetation units from the CCA, but only eight of these communities were somewhat similar to specific communities identified and described in the CCA. The comparison of the plant communities and vegetation units is given in Table 9.2. A map was compiled, showing the integrated map units in the whole corridor area (Figure 9.2). Four map units from the Expansion Areas could be integrated with communities from the CCA and two with land types in the CCA. It does however not imply that the plant communities in the similar map units between the CCA and the MGREA and PNPEA are the same in terms of species composition and environmental variables, but only that there are some similarities.

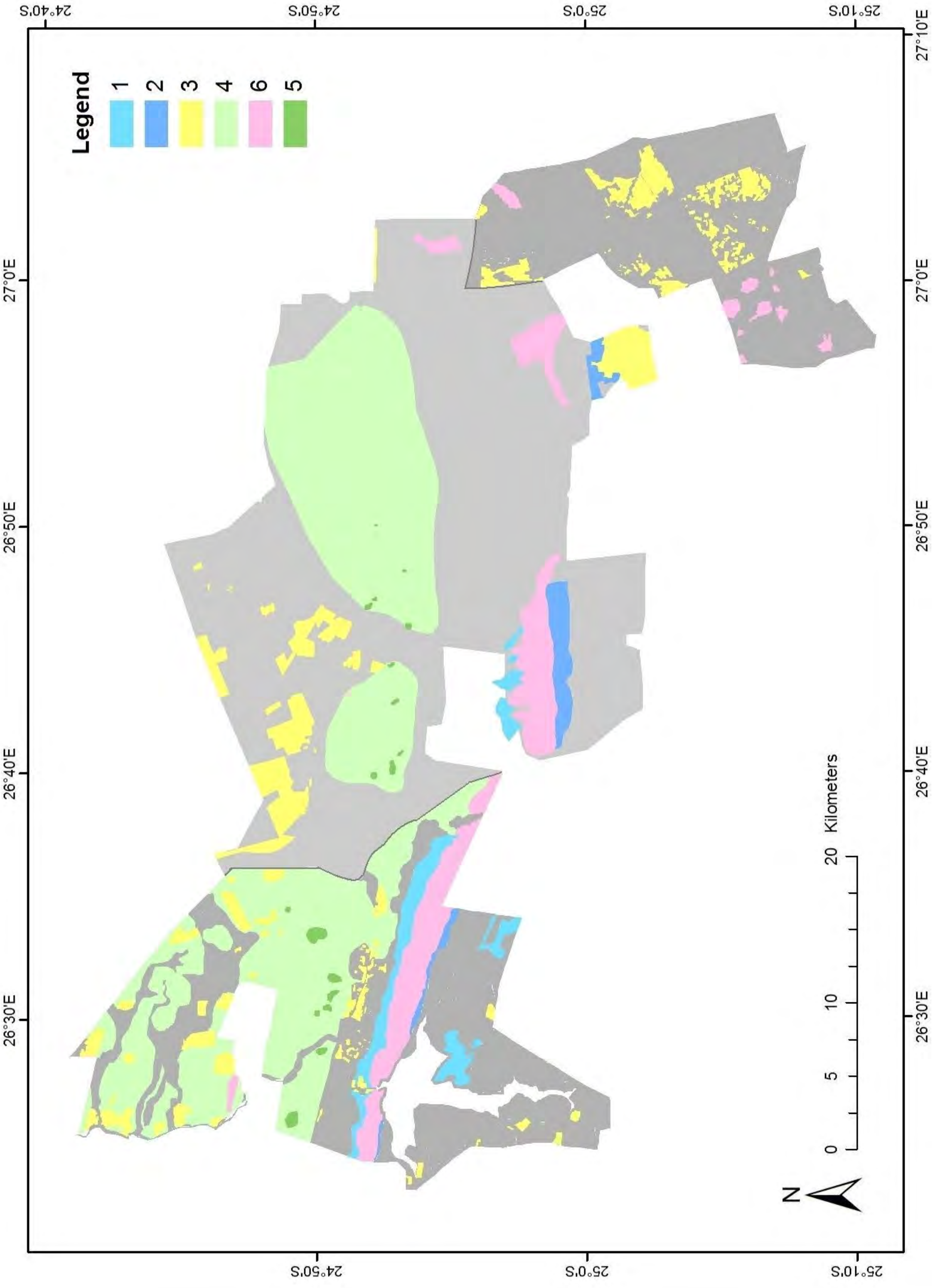

Figure 9.3 Integration of map units of MGREA, PNPEA and CCA. All grey areas indicate units that could not be integrated. See Table 9.2 for the names of the map units.

Table 9.3 Map units of Figure 9.3

Map unit (Figure 9.3)	Map unit in MGREA & PNPEA (Stalmans & De Wet, 2003)	Community/land type in the CCA
1	*Acacia mellifera* shrubland on Shortlands soil (MGREA)	Ae Community 3C: *Euclea undulata – Acacia tortilis* Community (very disturbed by overgrazing)
2	*Acacia erioloba – Terminalia sericea* woodlands on Clovelly soil (MGREA)	Ae community 4: *Acacia erioloba – Panicum maximum* Community
3	Lands and old lands on turf (PNPEA)	Ea Community 4: *Sorghum versicolor - Bothriochloa insculpta* Community
4	*Combretum imberbe* Woodlands on dolomite and shale (MGREA) Broad leaved woodlands on dolomitic flats (MGREA)	Fa land type
5	Broad-leaved woodlands of the dolomitic hills (MGREA)	Fa Community 4: *Pappea capensis - Kirkia wilmsii* Community
6	Broad-leaved woodlands of the Dwarsberg Mountains and Rand of Tweedepoort	Fb land type

Chapter 10
Concluding remarks

The first aim of this study was to identify, classify and describe the vegetation of the Central Corridor Area (CCA) of the proposed Heritage Park. This was done for the Ae, Ea, Fa and Fb land types respectively. A total of 20 communities and 17 sub-communities were identified and described. Some of these communities were similar to communities previously described by Morris (1972) in the Thabazimbi district; Van der Meulen (1979) in the former Western Transvaal, now known as the North-West Province; Pauw (1988) in the Atherstone Nature Reserve; Zacharias (1994) in Madikwe Game Reserve and Brown (1997) in the Borakalalo Nature Reserve. Ordinations were carried out using CANOCO, which clearly showed the correlations between environmental variables and specific plant communities. The environmental variables that had the greatest influence on these communities were clay percentage, soil depth and aspect.

The second aim was to map these plant communities. Most of the plant communities were mapped successfully; the sub-communities however could in most cased not be accurately mapped, due to their patchy occurrence. Some difficulties were encountered in mapping the communities of the Fb land type as this land type was very heterogeneous and some communities were under-sampled. The exact location of the communities of the Fb land type were sometimes uncertain and other communities or sub-communities that were not sampled at all might be present within the mapped communities. Community 5 of the Ae land type was found on clay patches within Community 1. The location of all these clay patches was uncertain and could therefore not be mapped. Communities 2 and 3 from the Ea land type were indicated in one map unit as the exact location of the two communities was uncertain.

The third aim was to combine the plant communities from the different land types into vegetation units and describe these in terms of species composition, environmental variables and management issues. A synopsis was done including the vegetation data from all four land types. Three vegetation units and four vegetation sub-units were identified and described. The first vegetation unit (the *Acacia robusta* – *Acacia tortilis* Vegetation Unit) was found on deep soil, on plains. Vegetation Unit 1 was divided into two sub-units, namely the *Eragrostis curvula* – *Setaria incrassata* Vegetation Sub-unit, which was found on soil with very high clay content and the *Ptycholobium plicatum* subsp. *plicatum* - *Ziziphus mucronata* Vegetation Sub-unit, which was found on less clayey soil. Vegetation Unit 1 was mostly similar to the microphyllous thorny *Acacia*-dominated vegetation described by Van der Meulen (1979) and Zacharias (1994). The second vegetation unit (the *Mundulea sericea* – *Vitex zeyheri* Vegetation Unit) was found on shallow sandy soil on plains. The third vegetation unit (the *Grewia flavescens* – *Panicum maximum* Vegetation Unit) was found on shallow sandy soil on mountains. Vegetation Units 2 and 3 showed similarities with the broad-leaved, *Combretum* dominated vegetation described by Zacharias (1994). There were similarities between these vegetation units and the broad vegetation types identified by Winterbach (1998) in the Central Savanna (Chapter 8). Recommendations were given for management of the different vegetation units.

The last aim was to integrate the data from this study carried out in the CCA with previous studies of adjacent areas (the Expansion Areas of Pilanesberg and Madikwe surveyed by Stalmans & De Wet, 2003). Achievement of this aim was only partly successful, as the two studies were carried out following different approaches. Broad units could be compared, but only eight of the 29 communities and sub-communities identified in the CCA, were found to be somewhat similar to communities identified in the Madikwe Game Reserve Expansion Area (MGREA) and the Pilanesberg National park Expansion Area (PNPEA). Only six map units from the two studies could be integrated.

It can therefore be concluded that most of the aims of this study have been successfully achieved.

As mentioned in Chapter 1 no in-depth vegetation studies were carried out inside the CCA before this one, which is why this study was essential for the successful planning, development and management of the proposed Heritage Park. This project will contribute greatly to providing the essential knowledge base of the ecosystems present in the CCA and specifically the vegetation of these ecosystems. The vegetation study of the CCA does not only contribute to the broader Heritage Park project, but also to the description and refinement of the vegetation types given by Mucina & Rutherford (2006) for the study area.

Three red data species and seven protected tree species were found in the CCA according to the red list and the list of protected tree species (South African National Biodiversity Institute, 2009; Department of Water Affairs and Forestry, 2007). The red data species are *Acacia erioloba*, *Boophone disticha* and *Hypoxis hemerocallidea* and they all fall into the 'Declining' category. Protected tree species are *Acacia erioloba, Boscia albitrunca, Combretum imberbe, Elaedendron transvaalensis, Erythrophysa transvaalensis, Sclerocarya* *birrea and Securidaca longepedunculata.* These trees may not be removed, cut, disturbed, damaged or destroyed according to the National Forests Act (84/1998).

The following recommendations were given in terms of management and future studies. In Chapter 8 more details were given.

- Passive as well as active control methods, such as reducing the number of grazers and introducing browsers, re-introducing regular fires, mechanical bush thinning and the application of arboricides have to be implemented to rectify the bush thickening problem and brush packing, ripping and over seeding and stabilization of gullies will be necessary to solve soil erosion problems. An in-depth study will however be necessary to determine the extent of these problems and the best way to solve it.
- Sand mining south of the Dwarsberg Mountains in Community 4 of the Ae land type has to be controlled to prevent the degradation and eventually total destruction of this community.
- Old cultivated fields can be kept open to provide better grazing and to improve visibility and therefore game viewing.
- Cultivated lands that are still in use can either be left to recover by itself or grass species, such as *Cenchrus ciliaris* can be sown to speed up the recovery process.
- The data from this study has to be integrated with the data from the soil and carrying capacity studies, which are carried out by researchers from the Tshwane University of Technology, to identify and describe management units.
- Care should be taken in future not to overstock the area, as this might contribute to further overgrazing, soil erosion and bush thickening.
- The Fb land type was under-sampled due to its great diversity and inaccessibility. More surveys should be done in the future, to get a better understanding of the total species diversity.
- In future, the Expansion Areas of Madikwe and Pilanesberg (MGREA and PNPEA) should also be surveyed in terms of forb species as well as species which can be regarded as diagnostic for the specific plant communities.
- Carrying out two relevés at each site, 200 m apart, created some problems in the data and this should be avoided in future studies. In most cases the relevés done at the same site were very similar, which represents less variation than would be sampled if they were done separately. In some cases the two relevés were different from each other, which implies that they did not fall into the same homogenous unit, as the 200 m transects were done up the slope and communities sometimes change 200 m up a slope (See Chapter 3 for more detail).

Appendix

Plant species check list of the Central Corridor Area of the proposed Heritage Park

1. Pteridophyta

Ophioglossaceae

Ophioglossum L.
O. lancifolium C.Presl
O. species

Pteridaceae

Cheilanthes Sw.
C. species
C. viridis (Forssk.) Sw.

Pellaea Link
P. calomelanos (Sw.) Link var. *calomelanos*

2. Angiospermae

2.1 Monocotyledonae

Amaryllidaceae

Ammocharis Herb.
A. coranica (Ker Gawl.) Herb.

Boophone Herb
B. disticha (L.f.) Herb.

Crinum L.
C. graminicola I.Verd.

Scadoxus Raf.
S. puniceus (L.) Friis & Nordal

Anthericaceae

Chlorophytum Ker Gaw
C. cooperi (Baker) Nordal
C. species
C. transvaalense (Baker) Kativu

Asparagaceae

Asparagus L.
A. laricinus Burch.
A. racemosus Willd.
A. setaceus (Kunth) Jessop
A. suaveolens Burch.

Asphodelaceae

Aloe L.
A. greatheadii Schönland
A. marlothii A.Berger,

Trachyandra Kunth
T. saltii (Baker) Oberm.

Commelinaceae

Commelina L.
C. africana L.
C. benghalensis L.

C. erecta L.
C. livingstonii C.B.Clarke
C. species

Cyperaceae

Bulbostylis Kunth

B. hispidula (Vahl) R.W.Haines var. *pyriformis* (Lye) R.w. Haines
B. humilis (Kunth) C.B.Clarke

Cyperus L.

C. fulgens C.B.Clarke
C. indecorus Kunth var. *decurvatus* (C.B.Clarke) Kük.
C. obtusiflorus Vahl
C. rupestris Kunth
C. species

Kyllinga Rottb.

K. alba Nees

Dracaenaceaea

Sansevieria Thunb.

S. aethiopica Thunb.

Eriospermaceae

Eriospermum Jacq. Ex Willd.

E. flagelliforme (Baker) J.C.Manning
E. bellendeni Sweet
E. porphyrium Archibald

Hyacinthaceae

Dipcadi Medik.

D. marlothii Engl.

Ledebouria Roth

L. apertiflora (Baker) Jessop
L. burkei J,C.Manning & Goldblatt subsp*. burkei*
L. cooperi (Hook.f.) Jessop
L. ovatifolia (Baker) Jessop
L. revoluta (L.f.) Jessop

Ornithogalum L.

O. durandianum (Schinz) J.C. Manning & Goldblatt
O. glaucescens J.C. Manning & Goldblatt
O. species

Hypoxidaceae

Hypoxis L.

H. acuminata Baker
H. hemerocallidea Fisch. & C.A.Mey.

Iridaceae

Gladiolus L.

G. elliotii Baker
G. permeabilis D.Delaroche

Poaceae

Acracne Wight & Arn. ex Chiov.

A. racemosa (Roem. & Schult.) Ohwi

Andropogon L.

A. chinensis (Nees) Merr.

Anthephora Schreb.

A. pubescens Nees

Aristida L.

- *A. adscensionis* L.
- *A. bipartita* (Nees) Trin. & Rupr.
- *A. canescens* Henrard
- *A. congesta* Roem. & Schult. ssp. *barbicollis* (Trin. & Rupr.) De Winter
- *A. congesta* Roem. & Schult. ssp.*congesta*
- *A. diffusa* Trin
- *A. junciformis* Trin. & Rupr
- *A. meridionalis* Henrard
- *A. rhiniochloa* Hochst.
- *A. scabrivalvis* Hack.
- *A. stipitata* Hack.

Bothriochloa Kuntze

- *B. insculpta* (A.Rich.) A.Camus

Brachiaria (Trin.) Griseb.

- *B. deflexa* (Schumach.) C.E.Hubb. ex Robyns
- *B. eruciformis* (Sm.) Griseb.
- *B. nigropedata* (Ficalho & Hiern) Stapf
- *B. serrata* (Thunb.) Stapf

Cenchrus L

- *C. ciliaris* L.

Chloris Sw.

- *C. virgata* Sw.

Chrysopogon Trin.

- *C. serrulatus* Trin.

Cymbopogon Spreng.

- *C. nardus* Rendle
- *C. pospischilii* (Stapf) Stapf ex Burtt Davy

Cynodon Rich

- *C. dactylon* (L.) Pers.

Dactyloctenium Willd.

- *D. aegyptium* (L.) Willd.

Dichanthium Willemet

- *D. annulatum* (Forssk.) Stapf var. *papillosum* (A.Rich.) de Wet & Harlan

Digitaria Haller

- *D. diagonalis* (Nees) Stapf
- *D. eriantha* Steud.
- *D. monodactyla* (Nees) Stapf
- **D. sanguinalis* (L.) Scop.
- *D. setifolia* Stapf

Diheteropogon (Hack.) Stapf

- *D. amplectens* (Nees) Clayton
- *D. filifolius* (Nees) Clayton

Dinebra Jacq.

- *D. retroflexa* (Vahl) Panz. var. *condensata* S.M.Phillips

Echinochloa P.Beauv.

- *E. pyramidalis* (Lam.) Hitchc. & Chase

Eleusine Gaertn.

- *E. coracana* (L.) Gaertn. subsp. *africana* (Kenn.-O'Byrne)

Elionurus Kunth ex Willd.

- *E. muticus* (Spreng.) Kunth

Enneapogon Desv. Ex P.Beauv
- *E. cenchroides* (Roem. & Schult.) C.E.Hubb.
- *E. scoparius* Stapf

Enteropogon Nees
- *E. macrostachyus* (A.Rich.) Benth.

Eragrostis Wolf
- *E. aspera* (Jacq.) Nees
- *E. bicolor* Nees
- *E. biflora* Hack. ex Schinz
- *E. chloromelas* Steud.
- *E. curvula* (Schrad.) Nees
- *E. gummiflua* Nees
- *E. inamoena* K.Schum.
- *E. lehmanniana* Nees
- *E. nindensis* Ficalho & Hiern
- *E. racemosa* (Thunb.) Steud.
- *E. rigidior* Pilg.
- *E. superba* Peyr.
- *E. trichophora* Coss. & Durieu
- *E. viscosa* (Retz.) Trin.

Eustachys Desv
- *E. paspaloides* (Vahl) Lanza & Mattei

Fingerhuthia Nees
- *F. africana* Lehm.

Heteropogon Pers.
- *H. contortus* (L.) Roem. & Schult.

Hyparrhenia E.Fourn.
- *H. filipendula* (Hochst.) Stapf
- *H. hirta* (L.) Stapf
- *H. tamba* (Steud.) Stapf

Ischaemum L.
- *I. afrum* (J.F.Gmel.) Dandy
- *I. fasciculatum* Brongn.

Loudetia Hochst. ex Steud.
- *L. simplex* (Nees) C.E.Hubb.

Melinis P.Beauv
- *M. nerviglumis* (Franch.) Zizka
- *M. repens* (Willd.) Zizka

Microchloa R.Br.
- *M. caffra* Nees

Oropetium Trin.
- *O. capense* Stapf

Panicum L.
- *P. coloratum* L.
- *P. maximum* Jacq.
- *P. schinzii* Hack.
- *P. volutans* J.G.Anderson

Pogonarthria Stapf
- *P. squarrosa* (Roem. & Schult.) Pilg.

Schizachyrium Nees
- *S. jeffreysii* (Hack.) Stapf

S. sanguineum (Retz.) Alston

Schmidtia Steud. Ex J.A. Schmidt
S. pappophoroides Steud.

Setaria P.Beauv.
S. incrassata (Hochst.) Hack.
S. lindenbergiana (Nees) Stapf
S. pumila (Poir.) Roem. & Schult
S. verticillata (L.) P.Beauv.

Sorghum Moench
S. versicolor Andersson

Sporobolus R.Br.
S. fimbriatus (Trin.) Nees
S. nitens Stent

Stipagrostis Nees
S. uniplumis (Licht.) De Winter

Themeda Forssk.
T. triandra Forssk.

Tragus Haller
T. berteronianus Schult.

Tricholaena Schrad. in Schult.
T. monachne (Trin.) Stapf & C.E.Hubb.

Trichoneura Anderson
T. grandiglumis (Nees) Ekman

Urelytrum Hack.
U. agropyroides (Hack.) Hack.

Urochloa P.Beauv.
U. mosambicensis (Hack.) Dandy

2.2 Dicotyledons

Acanthaceae
Asystasia Blume
A. schimperi T.Anderson

Barleria L.
B. macrostegia Nees
B. meyeriana Nees
B. pretoriensis C.B.Clarke
B. repens Nees

Blepharis Juss.
B. integrifolia (L.f.) E.Mey. ex Schinz
B. maderaspatensis (L.) B.Heyne ex Roth
B. subvolubilis C.B.Clarke

Crabbea Harv
C. acaulis N.E.Br.
C. angustifolia Nees
C. hirsuta Harv.

Dicliptera Juss
D. clinopodia Nees
D. eenii S.Moore

Hypoestes Sol. ex R.Br.
H. forskaolii (Vahl) R.Br.

Justicia L.
J. betonica L.
J. orchioides L.f.
J. protracta (Nees) T.Anderson

Monechma Hochst.
M. debile (Forssk.) Nees

Peristrophe Nees
P. transvaalensis (C.B.Clarke) K.Balkwill

Ruellia L.
R. cordata Thunb.
R. patula Jacq.

Ruelliopsis C.B.Clarke
R. setosa (Nees) C.B.Clarke

Siphonoglossa Oerst.
S.linifolia (Lindau) C.B.Clarke

Thunbergia Retz.
T. neglecta Sond.

Amaranthaceae
**Achyranthes* L.
A. aspera L.

Achyropsis (Moq.) Hook.f.
A. leptostachya (E.Mey. ex Meisn.) Baker & C.B.Clarke

Aerva Forssk.
A. leucura Moq.

**Alternanthera* Forssk.
A. pungens Humb., Bonpl. & Kunth

Amaranthus L
**Amaranthus hybridus* L

**Gomphrena* L.
G. celosioides Mart.

**Guilleminea* Kunth
G.densa (Willd.) Moq.

Kyphocarpa (Fenzl) Lopr.
K. angustifolia (Moq.) Lopr.

Pupalia Juss.
P. lappacea (L.) A.Juss.

Anacardiaceae
Lannea A.Rich.
L. discolor (Sond.) Engl.
L. schweinfurthii (Engl.) Engl.

Ozoroa Delile
O. paniculosa (Sond.) R.& A.Fern

Rhus L.
R. lancea L.f.

R. leptodictya Diels
R. pyroides Burch.

Sclerocarya Hochst.
S. birrea (A.Rich.) Hochst.

Apocynaceae
Ancylobotrys Pierre
A. petersiana (Klotzsch) Pierre

Asclepias L.
A. meliodora (Schltr.) Schltr.

Carissa L.
C. bispinosa (L.) Desf. ex Brenan

Gomphocarpus R.Bh.
G. fruticosus (L.) Aiton f. subsp. *decipiens* (N.E.Br.) Goyer & Nicholas

Cryptolepis R.Br.
C. oblongifolia (Meisn.) Benth. ex Schltr.

Pentarrhinum E.Mey.
P. insipidum E.Mey.

Raphionacme Harv
R. hirsuta (E.Mey.) R.A.Dyer ex E.Phillips
R. velutina Schltr.

Sarcostemma R.Br.
S. viminale (L.) R.Br.

Secamone R.Br.
S. parvifolia (Oliv.) Bullock

Tylophora R.Br.
T. flanaganii Schltr.

Araliaceae
Cussonia Thunb.
C. paniculata Eckl. & Zeyh.

Asteraceae
**Acanthospermum* Schrank
A. hispidum DC.

Aspilia Thouars
A. mossambicensis (Oliv.) Wild

Berkheya Ehrh.
B. species

Bidens L.
**B. bipinnata* L.
**B. pilosa* L.

Brachylaena R.Br.
B. rotundata S.Moore

Conyza Less.
C. podocephala DC.
C. species

Dicoma Cass.
D. anomala Sond.
D. macrocephala DC.

D. species
D. tomentosa Cass.

Felicia Cass.
F. mossamedensis (Hiern) Mendonça
F. muricata (Thunb.) Nees

**Flaveria* Juss.
F. bidentis (L.) Kuntze

Geigeria Griess.
G. burkei Harv.

**Helianthus* L.
H. annuus L.

Hirpicium Cass
H. bechuanense (S.Moore) Roessler

Laggera Benth
L. decurrens (Vahl) Hepper & J.R.I.Wood

Nidorella Cass.
N. anomala Steetz
N. resedifolia DC. subsp. *resedifolia*

Philyrophyllum O.Hoffm.
P. schinzii O.Hoffm.

Pseudognaphalum Kirp.
P. undulatum (L.) Hilliard & B.L.Burtt

Psiadia Jacq.
P. punctulata (DC.) Oliv. & Hiern ex Vatke

Senecio L.
S. consanguineus DC.
S. harveianus MacOwan
S. inaequidens DC.
S. oxyriifolius DC.
S. species

**Schkuhria* Roth
S. pinnata (Lam.) Cabrera

Sonchus L.
S. species

**Tagetes* L.
T. minuta L.

Tarchonanthus L.
T. camphoratus L.

Ursinia Gaertn.
U. nana DC.

Vernonia Schreb.
V. galpinii Klatt
V. oligocephala (DC.) Sch.Bip. ex Walp.
V. poskeana Vatke & Hildebr. subsp. *botswanica* G.V.Pope

**Zinnia* L.
Z. peruviana (L.) L.

Boraginaceae

Ehretia P.Browne
- *E. amoena* Klotzsch
- *E. rigida* (Thunb.) Druce

Heliotropium L.
- *H. steudneri* Vatke
- *H. strigosum* Willd.

Burseraceae

Commiphora Jacq.
- *C. africana* (A.Rich.) Engl.
- *C. glandulosa* Schinz
- *C. mollis* (Oliv.) Engl.
- *C. pyracanthoides* Engl.
- *C. schimperi* (O.Berg) Engl.

Cactaceae

**Opuntia* Mill.
- *O. ficus-indica* (L.) Mill.

Capparaceae

Boscia Lam.
- *B. albitrunca* (Burch.) Gilg & Gilg-Ben.
- *B. foetida* Schinz

Cadaba Forssk.
- *C. termitaria* N.E.Br.

Cleome L.
- *C. maculata* (Sond.) Szyszyl
- *C. monophylla* L.
- *C. oxyphylla* Burch. var. oxyphylla
- *C. rubella* Burch.

Maerua Forssk.
- *M. angolensis* DC.
- *M. cafra* (DC.) Pax

Caryphyllaceae

Pollichia Aiton
- *P. campestris* Aiton

Celastraceae

Elaeodendron Jacq.
- *E. transvaalense* (Burtt Davy) R.H.Archer

Gymnosporia (Wight & Arn.) Hook.f.
- *G. buxifolia* (L.) Szyszyl.
- *G. polyacantha* (Sond.) Szyszyl.
- *G. senegalensis* (Lam.) Loes.
- *G. tenuispina* (Sond.) Szyszyl.

Chenopodiaceae

Chenopodium L.
- **C. album* L.
- **C. carinatum* R.Br.

Salsola L.
- *S. capensis* Botsch.

Combretaceae

Combretum Loefl.
- *C. apiculatum* Sond.
- *C. hereroense* Schinz
- *C. imberbe* Wawra
- *C. molle* R.Br. ex G.Don

C. mossambicense (Klotzsch) Engl.
C. zeyheri Sond.

Terminalia L.
T. sericea Burch. ex DC.

Convolvulaceae
Convolvulus L.
C. sagittatus Thunb.
C. species

Evolvulus L.
E. alsinoides (L.) L.

Ipomoea L.
I. coscinosperma Hochst. ex Choisy
I. crassipes Hook.
I. gracilisepala Rendle
I. magnusiana Schinz
I. oblongata E.Mey. ex Choisy
I. obscura (L.) Ker Gawl.
I. ommaneyi Rendle
I. papilio Hallier f.
I. purpurea (L.) Roth
I. sinensis (Desr.) Choisy
I. species

Merremia Dennst.
M. palmata Hallier f.
M. verecunda Rendle

Xenostegia D.F.Austin & Staples
X. tridentata D.F.Austin & Staples subsp. *angustifolia* (Jacq.) Lejoly & Lisowski

Seddera Hochst.
S. capensis (E.Mey. ex Choisy) Hallier f.
S. suffruticosa (Schinz) Hallier f.

Crassulaceae
Crassula L.
C. lanceolata (Eckl. & Zeyh.) Endl. ex Walp. subsp. *transvaalensis* (Kuntze) Tölken

Kalanchoe Adans
K. lanceolata (Forssk.) Pers.
K. paniculata Harv.
K. rotundifolia (Haw.) Haw.
K. thyrsiflora Harv.

Cucurbitaceae

Citrullus Eckl. & Zeyh.
C. lanatus (Thunb.) Matsum. & Nakai

Coccinia Wight & Arn.
C. sessilifolia (Sond.) Cogn.

Cucumis L.
C. heptadactylus Naudin
C. hirsutus Sond.
C. metuliferus Naudin
C. zeyheri Sond.

Kedrostis Medik.
K. africana (L.) Cogn.
K. foetidissima (Jacq.) Cogn.

Momordica L.
M. balsamina L.

Trochomeria Hook.f.
T. macrocarpa (Sond.) Hook.f.

Zehneria Endl.
Z. marlothii (Cogn.) R.& A.Fern.

Euphorbiaceae
Acalypha L.
A. glabrata Thunb. var. *pilosa* Pax
A. indica L.
A. villicaulis Hochst. ex A.Rich.

Bridelia Willd.
B. mollis Hutch.

Croton L.
C. gratissimus Burch.

Euphorbia L.
E. clavarioides Boiss.
**E. heterophylla* L.
E. inaequilatera Sond. var. *inaquilatera*
**E. prostrata* Aiton
E. species

Flueggea Willd.
F. virosa (Roxb. ex Willd.) Voigt subsp. *virosa*

Jatropha L.
J. schlechteri Pax
J. zeyheri Sond.

Phyllanthus L.
P. loandensis Welw. ex Müll.Arg.
P. incurvus Thunb.
P. maderaspatensis L.
P. parvulus Sond.

Spirostachys Sond.
S. africana Sond.

Tragia L.
T. incisifolia Prain
T. meyeriana Müll.Arg.
T. rupestris Sond.

Dichapetalaceae
Dichapetalum Thouars
D. cymosum (Hook.) Engl.
D. macrocarpum Engl. ex K.Krause

Ebenaceae
Diospyros L.
D. lycioides Desf.

Euclea Murray
E. natalensis A.DC.
E. undulata Thunb.

Fabaceae
Abrus Adans
A. precatorius L. subsp. *africanus* Verdc.

Acacia Mill.

- *A. burkei* Benth.
- *A. caffra* (Thunb.) Willd.
- *A. erioloba* E.Mey.
- *A. erubescens* Welw. ex Oliv.
- *A. galpinii* Burtt Davy
- *A. grandicornuta* Gerstner
- *A. hereroensis* Engl.
- *A. karroo* Hayne
- *A. mellifera* (Vahl) Benth. subsp. *detinens*
- *A. nigrescens* Oliv.
- *A. nilotica* (L.) Willd. ex Delile subsp. *kraussiana* (Brenth.) Brenan
- *A. robusta* Burch.
- *A. tortilis* (Forssk.) Hayne

Albizia Durazz.

- *A. anthelmintica* (A.Rich.) Brongn.

Argyrolobium Eckl. & Zeyh.

- *A. tomentosum* (Andrews) Druce

Burkea Benth.

- *B. africana* Hook

Chamaecrista Moench

- *C. biensis* (Steyaert) Lock
- *C. mimosoides* (L.) Greene

Crotalaria L.

- *C. burkeana* Benth.
- *C. globifera* E.Mey.
- *C. lotoides* Benth.
- *C. sphaerocarpa* Perr. ex DC.

Dichrostachys (A,DC.) Wight & Arn.

- *D. cinerea* (L.) Wight & Arn.

Elephantorrhiza Benth.

- *E. elephantina* (Burch.) Skeels

Indigastrum Jaub. & Spach

- *I. costatum* (Guill. & Perr.) Schrire subsp. *macrum* (E.Mey.) Schrire

Indigofera L.

- *I. alternans* DC. var. *alternans*
- *I. charlieriana* Schinz var. *charlieriana*
- *I. circinnata* Benth. ex Harv.
- *I. comosa* N.E.Br.
- *I. cryptantha* Benth. ex Harv.
- *I. daleoides* Benth. ex Harv
- *I. filipes* Benth. ex Harv.
- *I. hedyantha* Eckl. & Zeyh.
- *I. heterotricha* DC.
- *I. holubii* N.E.Br.
- *I. laxeracemosa* Baker f.
- *I. melanadenia* Benth. ex Harv.
- *I. nebrowniana* J.B.Gillett
- *I. rhytidocarpa* Benth. ex Harv. subsp. *rhytidocarpa*
- *I. sessilifolia* DC.
- *I. setiflora* Baker
- *I.* species
- *I. vicioides* Jaub. & Spach var. *vicioides*
- *I. zeyheri* Spreng. ex Eckl. & Zeyh.

Lotononis (DC.) Eckl. & Zeyh.
L. calycina (E.Mey.) Benth.

Macrotyloma (Wight & Arn.) Verdc.
M. axillare (E.Mey.) Verdc.
M. species

Mundulea (DC.) Benth.
M. sericea (Willd.) A.Chev.

Neorautanenia Schinz
N. ficifolius (Benth.) C.A.Sm.

Peltophorum (Vogel) Benth.
P. africanum Sond.

Ptycholobium Harms
P. plicatum (Oliv.) Harms subsp. *plicatum*

Rhynchosia Lour.
R. densiflora (Roth) DC. subsp. *chrysadenia* (Taub.) Verdc.
R. minima (L.) DC.
R. nitens Benth
R. species
R. totta (Thunb.) DC. var. *totta*

Senna Mill.
S. italica Mill.

Sesbania Scop.
S. transvaalensis J.B.Gillett

Sphenostylis E.Mey.
S. angustifolia Sond.

Stylosanthes Sw.
S. fruticosa (Retz.) Alston

Tephrosia Pers.
T. capensis (Jacq.) Pers.
T. elongata E.Mey.
T. longipes Meisn.
T. purpurea (L.) Pers.
T. purpurea (L.) Pers. subsp. *leptostachya* (DC.) Brummitt var. *leptostachya*
T. rhodesica Baker f.

Vigna Savi
V. frutescens A.Rich. subsp. *frutescens* var. *frutescens*
V. vexillata (L.) A.Rich

Zornia J.F.Gmel.
Z. capensis Pers. Subsp. *capensis*
Z. linearis E.Mey.
Z. milneana Mohlenbr.

Flacourtiaceae
Scolopia
S. zeyheri (Nees) Harv.

Gentianaceae
Sebaea Sol. ex R.Br.
S. grandis (E.Mey.) Steud.

Geraniaceae
Monsonia L
M. angustifolia E.Mey. ex A.Rich.

Gisekiaceae

Gisekia L.

G. pharnacioides L. subsp. *pharnacioides*

Kirkiaceae

Kirkia Oliv.

K. wilmsii Engl.

Lamiaceae

Acrotome Benth. ex Endl.

A. inflata Benth.

Clerodendrum L.

C. suffruticosum Gürke var. *suffruticosum*

Leonotis (Pers.) R.Br.

L. leonurus (L.) R.Br

L. ocymifolia (Burm.f.) Iwarsson var. *schinzii* Gürke

L. species

Leucas Burm. ex R.Br.

L. capensis (Benth.) Engl.

L. martinicensis (Jacq.) R.Br.

L. neuflizeana Courbon

L. sexdentata Skan

Ocimum L.

O. angustifolium Benth.

O. americanum L.

Ortosiphon Benth.

O. amabilis (Bremek.) Codd

Salvia L.

**S. reflexa* Hornem.

Teucrium L.

T. trifidum Retz.

Vitex L.

V. zeyheri Sond.

Loranthaceae

Tapinanthus (Blume) Rchb.

T. species

Malpighiaceae

Sphedamnocarpus Planch.

S. pruriens (A.Juss.) Szyszyl.

Malvaceae

Abutilon Mill.

A. angulatum (Guill. & Perr.) Mast.

A. grandiflorum G.Don.

A. ramosum (Cav.) Guill. & Perr.

Hibiscus L.

H. calyphyllus Cav.

H. cannabinus L.

H. engleri K.Schum.

H. micranthus L.f.

H. pusillus Thunb.

H. sidiformis Baill.

H. trionum L.

Malvastrum A.Gray
M. coromandelianum (L.) Garcke

Pavonia Cav.
P. burchellii (DC.) R.A.Dyer
P. senegalensis (Cav.) Leistner
P. transvaalensis (Ulbr.) A.Meeuse

Sida L.
S. chrysantha Ulbr.
S. cordifolia L.
S. dregei Burtt Davy
S. ovata Forssk.
S. rhombifolia L. subsp. *rhombifolia*
S. spinosa L.

Menispermaceae
Antizoma Miers
A. angustifolia (Burch.) Miers ex Harv.

Mollluginaceae
Corbichonia Scop.
C. decumbens (Forssk.) Exell

Limeum L.
L. sulcatum (Klotzsch) Hutch. var. sulcatum
L. viscosum (J.Gay) Fenzl

Mollugo L.
M. cerviana (L.) Ser. ex DC.

Moraceae
Ficus L.
F. abutilifolia (Miq.) Miq.
F. cordata Thunb. subsp. *salicifolia* (Vahl) C.C.Berg
F. glumosa (Miq.) Delile
F. thonningii Blume

Nyctaginaceae
Boerhavia L.
**B. diffusa* L. var. *diffusa*

Commicarpus Standl.
C. pentandrus (Burch.) Heimerl

Ochnaceae
Ochna L.
O. pulchra Hook.

Oleaceae
Jasminum L.
J. streptopus E.Mey.

Menodora Humb. & Bonpl.
M. heterophylla Moric. ex DC. var. *australis*

Olaceae
Ximenia L.
X. americana L. var. *microphylla*
X. caffra Sond.

Orobanchaceae
Striga Lour.
S. asiatica (L.) Kuntze
S. forbesii Benth.

S. gesnerioides (Willd.) Vatke ex Engl.

Oxalidaceae
Oxalis L.
O. depressa Eckl. & Zeyh.
O. obliquifolia Steud. ex Rich.
O. smithiana Eckl. & Zeyh.

Passifloraceae
Adenia Forssk.
A. digitata (Harv.) Engl.

Pedaliaceae
Ceratotheca Endl.
C. triloba (Bernh.) Hook.f.

Dicerocaryum Bojer
D. eriocarpum (Decne.) Abels

Harpagophytum DC ex Meisn.
H. procumbens (Burch.) DC. ex Meisn.
H. zeyheri Decne.

Holubia Oliv.
H. saccata Oliv.

Sesamum L.
S. triphyllum Welw. ex Asch

Plumbaginaceae
Plumbago L.
P. zeylanica L.

Polygalaceae
Polygala L
P. hottentotta C.Presl
P. sphenoptera Fresen. var. *sphenoptera*

Securidaca L.
S. longepedunculata Fresen.

Polygonaceae
Oxygonum Burch. Ex. Campd.
O. delagoense Kuntze

Portulacaceae
Portulaca L.
P. kermesina N.E.Br.
P. quadrifida L.

Talinum Adans
T. arnotii Hook.f.
T. caffrum (Thunb.) Eckl. & Zeyh.

Proteaceae
Faurea Harv.
F. saligna Harv.

Ranunculaceae
Clematis L.
C. brachiata Thunb.

Rhamnaceae
Berchemia Neck. ex DC.
B. zeyheri (Sond.) Grubov

Ziziphus Mill.
Z. mucronata Willd. subsp. *mucronata*
Z. zeyheriana Sond.

Rubiaceae
Anthospermum L.
A. rigidum Eckl. & Zeyh

Canthium Lam.
C. gilfillanii (N.E.Br.) O.B.Mill.
C. mundianum Cham. & Schltdl.

Gardenia J.Ellis
G. volkensii K.Schum.

Kohautia Cham. & Schltdl.
K. amatymbica Eckl. & Zeyh.
K. virgata (Willd.) Bremek.

Nenax Gaertn.
N. species

Oldenlandia L.
O. herbacea (L.) Roxb.

Pavetta L.
P. zeyheri Sond.

Pentanisia Harv.
P. angustifolia (Hochst.) Hochst.

Rubia L.
R. horrida (Thunb.) Puff

Spermacoce Gaertn.
S. senensis (Klotzsch) Hiern

Vangueria Comm. ex Juss
V. infausta Burch subsp. *infausta*

Santalaceae
Osyris L.
O. lanceolata Hochst. & Steud.

Thesium L.
T. species
T. utile A.W.Hill

Sapindaceae
Erythrophysa E.Mey. ex Arn.
E. transvaalensis I.Verd.

Pappea Eckl. & Zeyh.
P. capensis Eckl. & Zeyh.

Sapotaceae
Englerophytum K.Krause
E. magalismontanum (Sond.) T.D.Penn.

Mimusops L.
M. zeyheri Sond.

Scrophulariaceae
Aptosimum Burch. ex Benth.

A. lineare Marloth & Engl.
A. procumbens (Lehm.) Steud.

Jamesbrittenia Kuntze
J. atropurpurea (Benth.) Hilliard
J. burkeana (Benth.) Hilliard

Solanaceae
Datura L.
D. ferox L.

Lycium L.
L. cinereum Thunb.

Physalis L.
P. angulata L.

Solanum L.
S. lichtensteinii Willd.
S. nigrum L.
S. panduriforme E.Mey.
S. retroflexum Dunal
S. rubetorum Dunal
S. sisymbrifolium Lam.
S. supinum Dunal
S. tettense Klotzch var. *renschii* (Vatke) A.E.Gonç.

Withania Pauguy
W. somnifera (L.) Dunal

Sterculiaceae
Dombeya Cav.
D. rotundifolia (Hochst.) Planch

Hermannia L.
H. boraginiflora Hook.
H. depressa N.E.Br.
H. glanduligera K.Schum.
H. quartiniana A.Rich.
H. stellulata (Harv.) K.Schum.
H. tomentosa (Turcz.) Schinz ex Engl.
H. linearis Schinz
H. odorata (Burch.) T.Cooke

Melhania Forssk.
M. acuminata Mast.
M. acuminata Mast. var. *agnosta* (K.Schum.) Wild
M. forbesii Planch. ex Mast.
M. prostrata DC.
M. virescens (K.Schum.) K.Schum.

Waltheria L.
W. indica L.

Strychnaceae
Strychnos L.
S. henningsii Gilg
S. madagascariensis Poir.
S. pungens Soler.
S. spinosa Lam.

Thymelaeaceae
Gnidia
G. caffra (Meisn.) Gilg
G. kraussiana Meisn. var *krausiana*

Tiliaceae

Corchorus L.

C. asplenifolius Burch.
C. kirkii N.E.Br.

Grewia L.

G. bicolor Juss.
G. flava DC.
G. flavescens Juss.
G. monticola Sond

Triumfetta

T. annua L.
T. sonderi Ficalho & Hiern

Urticaceae

Pouzolzia Gaudich.

P. mixta Solms

Velloziaceae

Xerophyta Juss

X. retinervis Baker

Verbenaceae

Chascanum E.Mey.

C. hederaceum (Sond.) Moldenke
C. pinnatifidum (L.f.) E.Mey.

Lantana L.

**L. camara* L.
L. rugosa Thunb.

Lippia L.

L. javanica (Burm.f.) Spreng.
L. rehmannii H.Pearson

Viscaceae

Viscum L.

V. capense L.f.
V. combreticola Engl.
V. rotundifolium L.f.

Vitaceaea

Cyphostemma (Planch.) Alston

C. flaviflorum (Sprague) Desc.
C. schlechteri (Gilg & M.Brandt) Desc. ex Wild & R.B.Drumm.
C. simulans (C.A.Sm.) Wild & R.B.Drumm.

Rhoicissus Planch.

R. tridentata (L.f.) Wild & R.B.Drumm.

Zygophyllaceae

Tribulus L.

T. terrestris L.

* Alien species
Species names according to Germishuizen *et al.* (2006)

References

ACOCKS, J.P.H. 1988. Veld types of South Africa. South Africa: Botanical Research Institute, Department of Agriculture and Water Supply.

ASHMAN, M.R. & PURI, G. 2005. Essential soil science: a clear and concise introduction to soil science. Malden: Blackwell Publishing.

BARAC, A.S. 2003. EcoRestore: A Decision Support System for the restoration of degraded rangelands in southern Africa. Potchefstroom: Pothefstroom University for Christian Higher Education. (Dissertation – M.Sc.)

BARRETT, A.S., BROWN, L.R., BARRETT, L. & HENZI, S.P. 2006. Phytosociology and plant community utilization by vervet monkeys of the Blydeberg Conservancy, Limpopo Province. *Koedoe,* 49(1):49-68.

BARROW, C.J. 2006. Environmental management for sustainable development. 2nd ed. New York: Routledge.

BEZUIDENHOUT, H. 1993. Syntaxonomy and Synecology of the Western Transvaal grassland. Pretoria: University of Pretoria. (Thesis – Ph.D.)

BEZUIDENHOUT, H. 2009. The classification, mapping and description of the vegetation of the Rooipoort Nature Reserve, Northern Cape, South Africa. *Koedoe*, 51(1):1-11, DOI 10.4102/koedoe.v51i1.695.

BOTHA, F. 2010. Verbal communication to the author. Potchefstroom.

BOTHMA, J. Du P. 2006. Game Ranch Management. 4th ed. Pretoria: Van Schaik Publishers.

BOONZAAIER, W.B. & COLLINSON, R.F.H. 2000. Pilanesberg National Park Management Plan. 2nd ed. Pilanesberg National Park Management Series. Rustenburg: Contour Project Managers & Collinson Consulting.

BOONZAAIER, W.B. & LOURENS, M. 2002. Heritage Park Concept Plan. 2nd ed. Pilanesberg National Park management series, for the North West Parks and Tourism Board. Rustenburg: Contour Project Managers and Grant Thornton Kessel Feinstein.

BREDENKAMP, G.J. & BEZUIDENHOUT, H. 1995. A proposed procedure for the analysis of large phytosociological datasets in the classification of South African grassland. *Koedoe,* 38(1):33-39.

BREDENKAMP G.J., FERGUSON, J.W.H., FOORD, S.H. & DE FREY, W.H. 1999. Floristic assessment of an Afromontane grassland fragmentation experiment in a pine plantation. *African Journal of Ecology,* 37:49-60.

BROWN, L.R. 1997. A plant ecological study and wildlife management plan of the Borakalalo Nature Reserve. North-West Province. Pretoria: University of Pretoria. (Thesis –Ph.D.)

CAWTHORN, R.G., EALES, H.V., WALRAVEN, F., UKEN, R. & WATKEYS, M.K. 2006. The Bushveld Complex. (*In* Johnson, M.R., Anhaeusser, C.R. & Thomas, R.J., *ed*. The Geology of South Africa. Pretoria: The Geological Society of South Africa and the Council for Geoscience.)

CHENJE, M. & JOHNSON, P. 1994. State of the environment in Southern Africa. Johannesburg: The Penrose Press.

CILLIERS, S.S. 1998. Phytosociological studies of urban open spaces in Potchefstroom, North West Province, South Africa. Potchefstroom: Potchefstroom University for Christian higher education. (Thesis –Ph.D.)

COETZEE B.J. 1972. ‘n Plantsosiologiese studie van die Jack Scott-Natuurreservaat. Pretoria: University of Pretoria. (Dissertation – M.Sc.)

COETZEE, B.J. 1974. A phytosociological classification of the vegetation of the Jack Scott Nature Reserve. *Bothalia*, 11(3):329-347.

COETZEE, B.J. 1975. A phytosociological classification of the Rustenburg Nature Reserve. *Bothalia*, 11(4):561-580.

COUGHENOUR, M.B. & ELLIS, J.B. 1993. Landscape and climatic control of woody vegetation in a dry tropical ecosystem: Turkana district, Kenya. *Journal of Biogeography*, 20(4):383-398.

DAEMANE, M.E. 2007. An ecological study of the plant communities and degraded areas of the Highveld National Park, North West Province, South Africa. Potchefstroom: North West University. (Dissertation – M.Sc.)

DE KLERK, J.N. 2004. Bush encroachment in Namibia. Ministry of environment and tourism, The government of the Republic of Namibia. Namibia: John Meinert Printing.

DENGLER, J., CHYTRÝ, M. & EWALD, J. 2008. Phytosociology. (*In* Encyclopedia of Ecology, 4:2767-2779.)

DEPARTMENT OF ENVIRONMENTAL AFFAIRS AND TOURISM. 2006. South Africa Environment Outlook. A report on the state of the environment. Pretoria: Department of Environmental Affairs and Tourism.

DEPARTMENT OF WATER AFFAIRS AND FORESTRY. 2007. Notice of list of protected tree species under the National Forests Act 1998 (Act no. 84 of 1998).

DIAMANTIS, D. 2004. Ecotourism. Croatia: Thomson Learning.

EDWARDS, D. 1983. A broad-scale structural classification of vegetation for practical purposes. *Bothalia*, 14:705-712.

ERIKSSON, P.G., ALTERMANN, W. & HARTZER, F.J. 2006. The Transvaal Supergroup and its precursors. (*In* Johnson, M.R., Anhaeusser, C.R. & Thomas, R.J., *ed*. The Geology of South Africa. Pretoria: The Geological Society of South Africa and the Council for Geoscience)

GERMISHUIZEN, G., MEYER, N.L., STEENKAMP, Y & Keith, M. *eds*. 2006. A checklist of South African plants. South African Botanical Diversity Network Report No. 41. Pretoria: SABONET.

GÖTZE, A.R. 2002. The classification of plant communities and the evaluation of restoration technologies in different land-use areas in the Vembe Dongola National Park, Northern Province, South Africa. Potchefstroom: Potchefstroom University for Christian Higher Education (Dissertation – M.Sc.)

GREYLING, T. 2005. Factors affecting possible management for the Namib Feral Horses. Potchefstroom: North-West University, Potchefstroom Campus. (Dissertation - M.Sc.)

GROBLER, C.H., BREDENKAMP, G.J. & BROWN, L.R. 2005. Primary grassland communities of urban open spaces in Gauteng, South Africa. *South African Journal of Botany*, 72:367-377.

HENNEKENS, S.M. 1996a. TURBOVEG: Software package for input, processing and presentation of phytosociological data. IBN-DLO, University of Lancaster.

HENNEKENS, S.M. 1996b. MEGATAB: A visual editor for phytosociological tables. Giesen & Gertus, Ulft.

HERITAGE PARK. 2010. Heritage Park. http://www.heritage-park.co.za Date of access: 10 April 2010.

HILL, M.O. 1979. TWINSPAN: a Fortran program for arranging multivariate data in an ordered two-way table by classification of individuals and attributes. Ithaca, New York: Cornell University

HUDAK, A.T. 1999. Rangeland mismanagement in South Africa: Failure to apply ecological knowledge. *Human ecology*, 27(1):55-78.

HUDAK, A.T. & WESSMAN, C.A. 2001. Textural analysis of high resolution imagery to quantify bush encroachment in Madikwe Game Reserve, South Africa, 1955 – 1996. *International Journal of Remote Sensing*, 22(14):2731-2740.

HUNTER, M.L. 2002. Fundamentals of Conservation Biology. 2nd ed. Massachusetts: Blackwell Science.

IUCN. 2009a. Resolutions and recommendations. Gland: IUCN.

IUCN. 2009b. Shaping a sustainable future. The IUCN programme 2009 – 2012. Barcelona: World Conservation Congress. 5 – 14 October.

JOHNSON, M.R., ANHAEUSSER, C.R. & THOMAS, R.J. 2006. The geology of South Africa. Johannesburg: The Geology Society of South Africa & Pretoria: Council of Geoscience.

JOUBERT, D.F., ROTHAUGE, A. & SMIT, G.N. 2008. A conceptual model of vegetation dynamics in the semiarid Highland savanna of Namibia, with particular reference to bush thickening by *Acacia mellifera*. *Journal of Arid Environments*, 72(12):2201-2210, Dec.

KELLEY, A.J., OGG, C.M. & WILSON, M.A. 2008. Rationale for plinthic horizon in soil taxonomy. Proceedings of Southern Regional Cooperative Soil Survey Conference: Innovative technologies for the new soil survey. Florida: University of Florida.

KENT, M. & COKER, P. 1992. Vegetation description and analysis. Chichester: Wiley. Reprint South Africa: Content solutions.

KIRKMAN, K, MORRIS, G & PENDERIS, C. 2009. Multivariate statistics: Course notes for BOIL 701. Pietermaritzburg: University of Kwazulu-Natal.

LAND TYPE SURVEY STAFF. 1988. Land Types of the Maps: 2426 Thabazimbi; 2428 Nylstroom. Memoirs on the Agricultural Natural Resources of South Africa No. 10. South Africa: ARC - Institute for Soil, Climate and Water.

LEPŠ, J. & ŠMILAUER, P. 2003. Multivariate Analysis of Ecological Data using CANOCO. Cambridge, United Kingdom: Cambridge University Press.

LOW, A.B. & REBELO, A.G. 1998. Vegetation of South Africa, Lesotho and Swaziland. Pretoria: Department of Environmental Affairs and Tourism.

MADIKWE DEVELOPMENT TASK TEAM. 1994. Madikwe Game Reserve management plan. Rustenburg.

MANGOLD, S., MOMBERG, M. & NEWBURY, R. 2002. Biodiversity and conservation. (In State of the environment report: North West Province, South Africa. Pretoria: Mzuri Consultants).

MCCARTY, T. & RUBIDGE, B. 2005. The story of Earth and life: A Southern African perspective on a 4.6-billion-year journey. Johannesburg: University of the Witwatersrand, Struik Publishers.

MEFFE, G.K. & CARROLL, C.R. 1997. Principles of Conservation Biology. 2nd ed. Massachusetts: Sinauer Associates.

MÖHR, P.J. 1977. Handleiding vir mielieproduksie en die mielierekenaar. Pretoria: Misstof Vereniging van Suid-Afrika (MVSA) Publikasie nr. 61.

MONKHOUSE, F.J., STEYN, J.N. & BOSHOFF, L.P. 1983. A Dictionary of Geography, South African Edition. Pretoria: De Jager-Haum Publishers.

MORGENTHAL, T.L. 2000. Vegetation dynamics and management models for coal-ash disposal sites at Hendrina Power Station, Mpumalanga, South Africa. Potchefstroom: Potchefstroom University for Christian Higher Education (Dissertation – M.Sc.)

MORRIS, P.P.J. 1972. 'n Ekologiese ondersoek van die samestelling en struktuur van die verteenwoordigende plantgemeenskappe van die soetveld, met spesiale aandag aan die invloed van edafiese faktore op die verspreiding van houtagtige spesies. Potchefstroom: P.U. vir C.H.O. (North-West University). (Dissertation – M.Sc.)

MOSTERT, T.H.C, BREDENKAMP, G.J. & MOSTERT, R.E. 2009. Plant communities of the Soutpansberg Arid Northern Bushveld. *Koedoe*, 51(1):1-11, DOI 10.4102/koedoe.v51i1.687.

MUCINA, L. & RUTHERFORD, M.C. (eds) 2006. The vegetation of South Africa, Lesotho and Swaziland. Strelitzia 19. Pretoria: South African National Biodiversity Institute.

MUCINA, L., RUTHERFORD, M.C. & POUWRIE, L.W. 2005. Vegetation map of South Africa, Lesotho and Swaziland, 1:1 000 000 scale sheet maps. Pretoria: South African National Biodiversity Institute.

MUCINA, L. & VAN TONGEREN, O.F.R. 1989. A coenocline of the high-ranked syntaxa of ruderal vegetation. *Vegetatio*, 81:117-125.

MUELLER-DOMBOIS, D. & ELLENBERG, H. 1974. Aims and Methods of Vegetation Ecology. New York: Wiley.

OWEN-SMITH, N. 1999. The animal factor in veld management. (*In* Tainton, N., *ed*. Veld management in South Africa. Pietermaritzburg: University of Natal Press. p. 117-138.)

PAUW, J.C. 1988. Riglyne vir die bestuur van die natuurlewe in die bosveldgemeenskappe van die Atherstone Natuurreservaat in die Noordwes-Transvaal. Pretoria: University of Pretoria. (Dissertation – M.Sc.)

PIENAAR, F.C. 2006. A plant ecological evaluation of mechanical bush thinning in Marakele Park, Limpopo province. Bloemfontein: University of the Free State. (Dissertation - M.Sc.)

PPC. 2009. PPC Cement overview. http://www.ppc.co.za/cement Date of access: 10 June 2009.

PRIMACK, R.B. 2008. A primer of Conservation Biology. 4th ed. Sunderland: Sinauer Associates.

PUTTER, J. 2004. Vegetation dynamics of urban open spaces subjected to different anthropogenic influences. Potchefstoom: North-West University, Potchefstroom Campus. (Dissertation - M.Sc.)

REID, D.G. 1999. Ecotourism development in Eastern and Southern Africa. Harare: Weaver Press.

ROQUES, K.G., O'CONNOR, T.G. & WATKINSON, A.R. 2001. Dynamics of shrub encroachment in an African savanna: Relative influences of fire, herbivory, rainfall and density dependence. *Journal of Applied Ecology,* 38(2):268-280, April.

RUTHERFORD, M.C. & WESTFALL, R.H. 1994. Biomes of southern Africa: an objective categorization. Pretoria: National Botanical Institute.

SCARPE, C. 1990. Shrub layer dynamics under different herbivore densities in an arid savanna, Botswana. *Journal of Applied Ecology*, 27:873-885.

SCHOLES, R.J. 1990. The influence of soil fertility on the ecology of southern African dry savannas. *Journal of Biogeography*, 17(4/5):415-419.

SIEBERT, F. & ECKHARDT, H.C. 2008. The vegetation and floristics of the Nkhulhu exclosures, Kruger National Park. *Koedoe*, 50(1):126-144.

SIMELANE, T.S, KERLEY, G.I.H. & KNIGHT, M.H. 2006. Reflection of the relationships between communities and conservation areas of South Africa: the case of five South African national parks. *Koedoe*, 49(2):85-102.

SNYMAN, H.A. 1999. Soil erosion and conservation. (*In* Tainton, N., *ed*. Veld management in South Africa. Pietermaritzburg: University of Natal Press. p. 355-380.)

SMIT, G.N., RICHTER, C.G.F. & AUCAMP, A.J. 1999. Bush encroachment: An approach to understanding and managing the problem. (*In* Tainton, N., *ed*. Veld management in South Africa. Pietermaritzburg: University of Natal Press. p. 246-260.)

SOIL CLASSIFICATION WORK GROUP, 1991. Grondklassifikasie: 'n Taksonomiese sisteem vir Suid-Afrika. *Memoirs on the Natural Resources of South Africa, nr. 15.* Pretoria: Department of Agricultural Development.

SOIL SCIENCE SOCIETY OF SOUTH AFRICA. 1990. Handbook of standard soil testing methods for advisory purposes, Pretoria: Soil Science Society of South Africa.

SOUTH AFRICA. 2007. Notice of list of protected tree species under the national Forests Act. (Proclamation No. 817, 1998.) Government gazette, 30253:47, 7 September.

SOUTH AFRICAN NATIONAL BIODIVERSITY INSTITUTE (SANBI). 2009a. Interim Red Data List of South African Plant Taxa.
http://www.sanbi.org/biodiversity/redlist/ Date of use: 19 October 2009.

SOUTH AFRICAN WEATHER SERVICES. DE VILLIERS, C. (Coleen.deVilliers@weathersa.co.za) 10 Mrt. 2010. Weather data for Pilanesberg and Thabazimbi. E-mail to: La Grange, M. (13007912@student.nwu.ac.za).

SPOSITO, G. 1989. The Chemistry of soils. New York: Oxford University Press.

STALMANS, M. 2007. Review and update of the Madikwe Game Reserve Management Plan. Setting thresholds of potential concern for vegetation. International Conservation Services CC.

STALMANS, M. & DE WET, F. 2003. Soils and vegetation of the Madikwe and Pilanesberg Expansion Areas in the Heritage Park, North West Province. Rustenburg: International conservation services.

SUTHERLAND, W.J. 2000. The conservation handbook: research, management and policy. Cambridge: University Press.

TOBLER, M.W., COCHARD, M. & EDWARDS, P.J. 2003. The impact of cattle ranching on large-scale vegetation patterns in a coastal savanna in Tanzania. *Journal of Applied Ecology*, 40:430-444.

TAINTON, N.M. & HARDY, M.B. 1999. Introduction to the concepts of development of vegetation. (*In* Tainton, N., *ed*. Veld management in South Africa. Pietermaritzburg: University of Natal Press. p. 1-22.)

TER BRAAK,C.J.F. 1988. CANOCO: A Fortran program for canonical community ordinations. Microcomputer Power. New York: Ithaca.

VAN DER MEULEN, F. 1979. Plant sociology of the western Transvaal Bushveld, South Africa: A syntaxonomic and synecological study. Germany: Straus & Cramer.

VAN DER MEULEN, F. & WESTFALL, R.H. 1979. A vegetation map of the western Transvaal Bushveld. *Bothalia*, 12(4):731-735.

VAN HOVEN, W. 2006. Nutrition. (*In* Bothma, J. du P., *ed*. Game Ranch Managent. 4th ed. Pretoria: Van Schaik Publishers. p. 243-276.)

VAN OUDTSHOORN, F. 2004. Gids tot grasse van Suider-Afrika. 2de uitg. Pretoria: Briza.

VAN ROOYEN, N. 2006. Habitat evaluation. (*In* Bothma, J. du P., *ed*. Game Ranch Managent. 4th ed. Pretoria: Van Schaik Publishers. p. 75-94.)

VAN STADEN, P.J. & BREDENKAMP, G.J. 2005. Major plant communities of the Marakele National Park. *Koedoe*, 48(2):59-70.

VAN WYK, A.E. & MALAN, S.J. 1998. Field guide to the wild flowers of the Highveld. Cape Town: Struik Publishers.

VAN WYK, E. 1998. Plantegroeistudies van die Klerkdorpse Munisipale gebied: ‘n floristiese en fitososiologiese studie. Potchefstoom: Potchefstroomse Universiteit vir Christelike Hoër Onderwys. (Dissertation - M.Sc.)

VAN WYK, S & BREDENKAMP, G.J. 1986. ‘n Braun-Blanquet-klassifikasie van die plantegroei van die Abe Bailey-Natuurreservaat. *South African Journal of Botany*, 52:321-331.

VELDSMAN, S.G. 2008. Vegetation degradation gradient and ecological index of key grass species in the south-eastern Kalahari, South Africa. Pretoria: University of Pretoria. (Dissertation - M.Sc.)

VENTER, F.J. & GERTENBACH, W.P.D. 1986. A cursory review of the climate and vegetation of the Kruger National Park. *Koedoe*, 29:139-148.

WERGER, M.J.A. 1974. The place of the Zürich-Montpellier method in vegetation science. *Folia Geobotanica & phytotaxonomica*, 9(1):99-109.

WINEGARDEN, D.L. 1995. An introduction to soils for environmental professionals. Boca Raton: Lewis Publishers.

WINTERBACH, R. 1998. A phytosociological synthesis of the *Acacia tortilis* communities in the North-Western savanna of South Africa. Pretoria: University of Pretoria. (Dissertation - M.Sc.)

ZACHARIAS, P. 1994. The vegetation of Madikwe – a first approximation. Unpublished report of the North West Parks & Tourism board.